# GEOGRAPHICAL REVIEW OF INDIA

VOL. XXIII DECEMBER 1961 NO. 4


PUBLISHED BY

THE GEOGRAPHICAL SOCIETY OF INDIA

SENATE HOUSE

CALCUTTA-12

# The Geographical Society of India

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The *Review* is published quarterly. It contains mainly original papers read before the Society ; but it also includes articles, notes, reviews etc. useful for professional geographers, students, teachers, as well as for those generally interested in the subject.



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GEOGRAPHICAL REVIEW
OF
INDIA

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# AN OUTLINE OF THE GEOGRAPHY OF HAWAII AND THE TENTH PACIFIC SCIENCE CONGRESS, 1961*

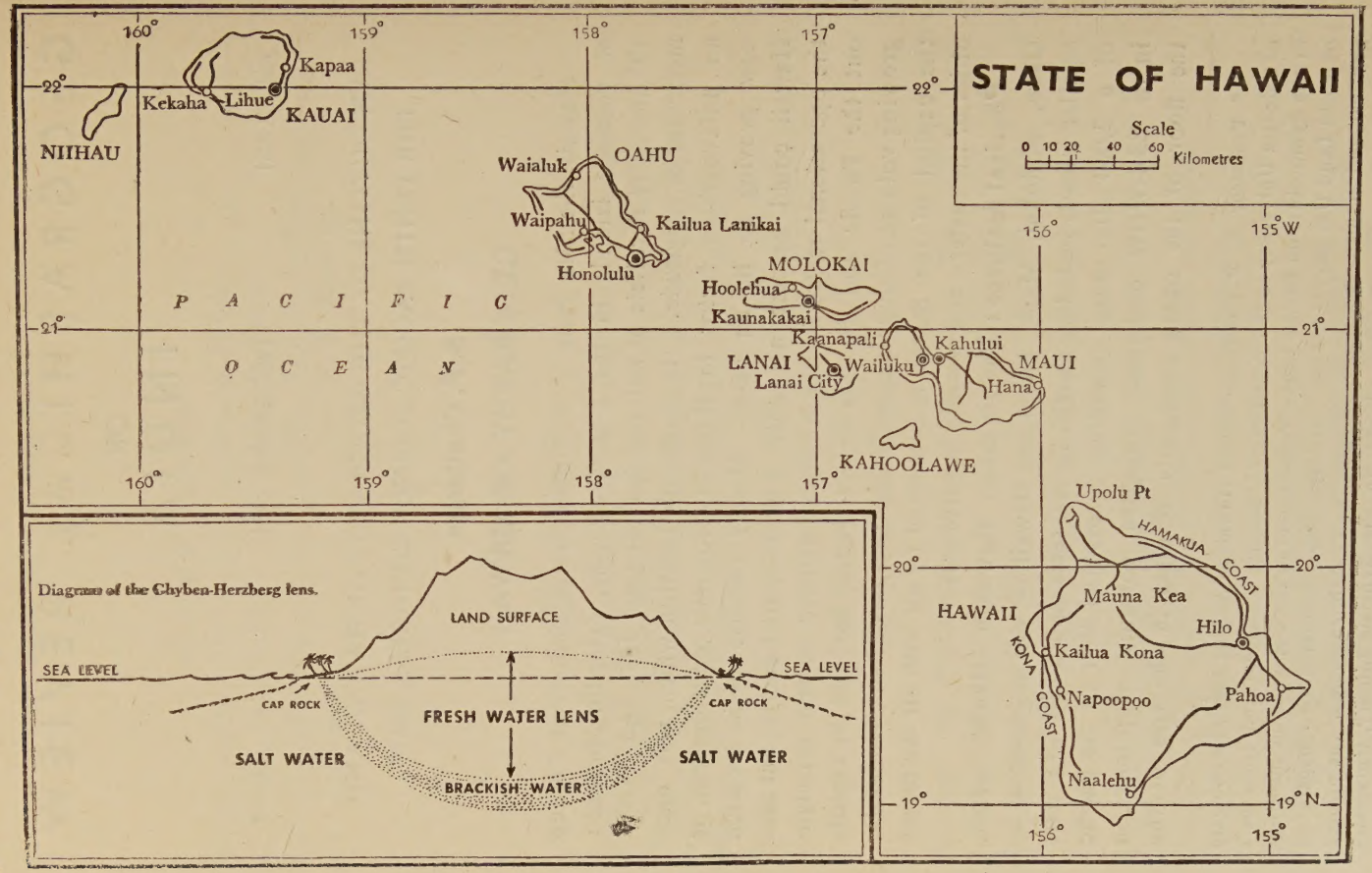
**S. P. Chatterjee**

## GEOGRAPHY OF HAWAII

Hawaii, the 50th State of the United States, comprises a group of volcanic islands in the Central Pacific, extending between 19° and 21°N Parallels of latitude and between 155° and 157°W meridians of longitude. Its geographic location which was once an unfavourable factor in Hawaii's economic development, is now proving to be an asset. Mainly because of its location Hawaii could become not only a world tourist centre, but also the operational centre for the American defence system throughout the Pacific and the only Central Pacific port for the rapidly growing volume of shipping and air transportation. Honolulu, the capital of the State, is connected by air with all the major cities of the eastern and western hemispheres.

**Physical features :** The six major Hawaiian Islands, Kauai, Oahu, Molokai, Maui, Lanai and Hawaii as well as hundreds of smaller islands including shoals, banks, reefs and atolls are part of a 2,000-mile range extending across the floor of the Pacific in a ESE-WNW direction. Repeated volcanic eruptions on the floor of the ocean eventually resulted in the rise of the

* Professor S. P. Chatterjee visited Hawaii in August 1961 as a delegate of Calcutta University to the Tenth Pacific Science Congress and took part in the Symposium on Pacific Island Terraces and in the Commission meetings of world Land Use Survey. Prof. Chatterjee also contributed two papers on physical and human geography of India, and exhibited some of the printed National Atlas maps (English edition) in the Synclair Library, University of Hawaii.


STATE OF HAWAII
Scale
0 10 20 40 60 Kilometres
160°
159°
158°
157°
156°
155°W
22°
21°
20°
19°
19°N
Kapaa
Kekaha
Lihue
KAUAI
NIIHAU
Waialuk
OAHU
Waipahu
Kailua Lanikai
Honolulu
MOLOKAI
Hoolehua
Kaunakakai
Kaanapali
Kahului
LANAI
Lanai City
Wailuku
MAUI
Hana
KAHOOLAWE
P A C I F I C
O C E A N
Upolu Pt
HAMAKUA COAST
HAWAII
Mauna Kea
Hilo
Kailua Kona
KONA COAST
Napoopoo
Pahoa
Naalehu
Diagram of the Ghyben-Herzberg lens.
LAND SURFACE
SEA LEVEL
SEA LEVEL
CAP ROCK
CAP ROCK
FRESH WATER LENS
SALT WATER
SALT WATER
BRACKISH WATER

volcanic mountains above sea level in the Pliocene times, some 13 million years ago, thereby forming in general the mountain-top-islands that now constitute the State of Hawaii, and in particular the two highest peaks in the State, Mauna Kea (13,784 ft.) and Mauna Loa (13,679 ft.). Both these mountains have roots going down another 20,000 ft. to the floor of the ocean, and if this is taken into account Mauna Loa could be considered as the largest single mountaion mass in the world. The volcanoes in Oahu are extinct today, though the crater wall of the Diamond Head is still a conspicuous landmark in the island. The two volcanic ranges, the Koolau range and the Waianea mountains rise to an average height of 3,000 ft. (Mt. Kaala, 4,025 ft. highest peak) and run more or less parallel to the coast. On weathering these ranges have given rise to thin spurs which alternate with narrow short valleys. A longitudinal basin occurs between the two ranges extending from Pearl Harbour northwards to the Wailua Bay, and providing sites for intensive cultivation, settlement, and easy communication to Honolulu from the perepheral part of the island. The coastal plains are narrow and dotted with homesteads. The supply of water for domestic and agricultural purposes is one of the greatest problems, which has been tackled successfuly by tapping the Ghyben-Herzberg fresh water lens, which owes its origin to the sinking of rain water through permeable lavas and then floating on salt water that moves in from the surrounding Pacific Ocean. The lens shape results because of the movement of vast quantities of fresh water from inland toward the coastal rim of the island where it discharges into the sea, and the thickening of the lens is due to the presence of a thick wedge of nearly impervious 'caprock' at the coast.

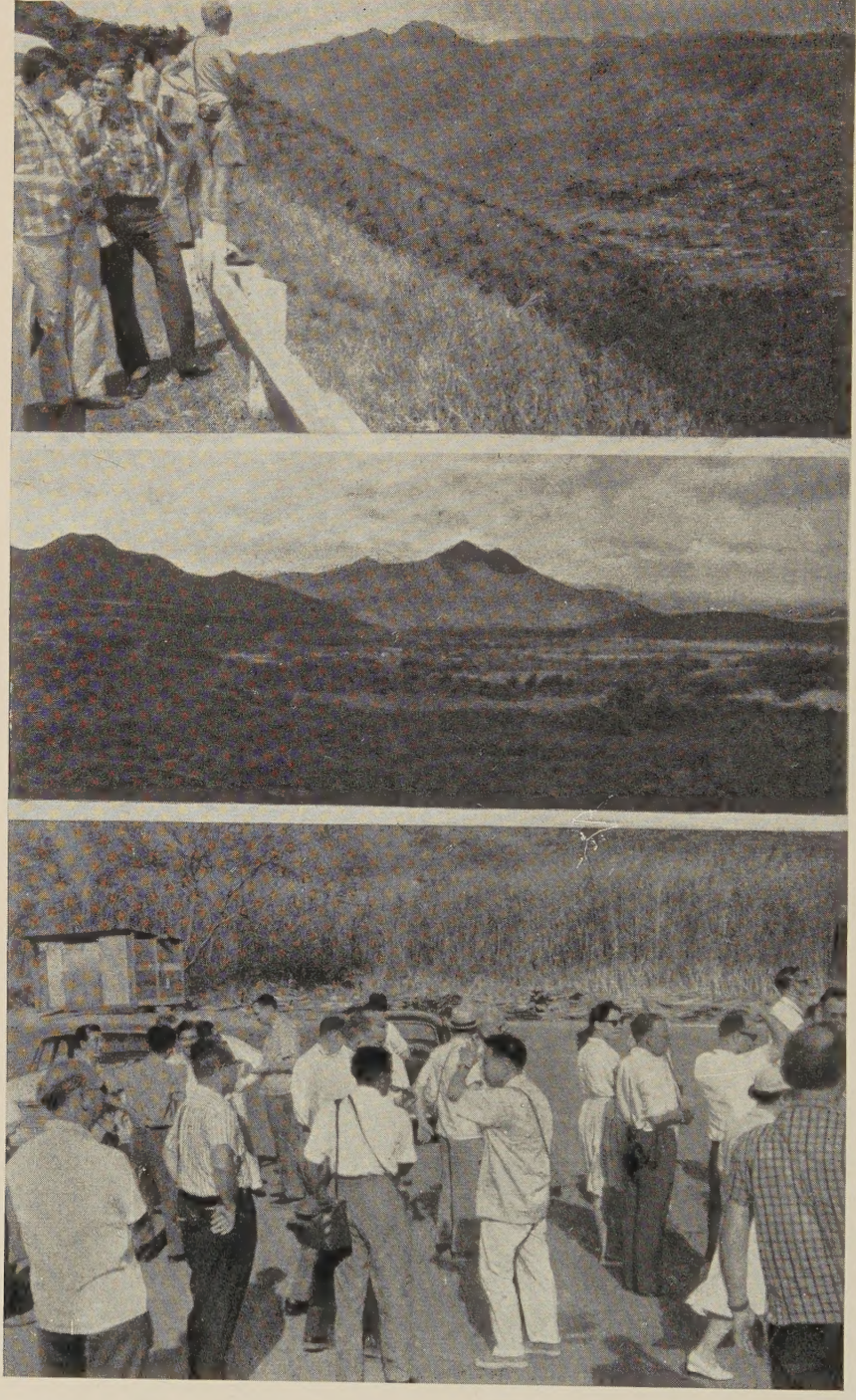
**Climate** : Everywhere near sea level the land is immersed in warm mild air from off the Ocean. In winter as in summer the temperature ranges from $60^0$ to $90^0$F with an annual average of $74^0$ and a variation of only $8^0$ between the average temperatures of the warmest and coldest months. Thus, extremly hot or cold days are rare. The mountains are of course much cooler. On the higher slopes of Mauna Loa and Mauna Kea night-time temperatures are frequently below freezing and sometimes below $20^0$F. There are almost continuous mild tradewinds, which form a dominant element of the Hawaiian climate. From May to September which is the summer season ( i. e., *Kau* season ) they blow for most of the time, and from

October to April ( winter or *hoo-ilo* season ) over three-fifths of the time. The *Kau* is the season of the trades with only light showers in the lowlands though with frequent heavy showers in the Mountains. In the *hoo-ilo* season occasional torrential rainstorms occur. Rainfall varies considerably from place to place ranging from 10 inches to over 600 inches. Mount Waialeale in Kauai is perhaps the wettest spot in the world, receiving in some years as much as 600 inches of rainfall or even more But only two miles away from the mountainous tract the average rainfall is only 150 inches. Even within the city of Honolulu in Oahu the rainfall gradients are extreme. There at Waikiki the rainfall is 23 inches, whereas on the University of Hawaii Campus in the lower Manoa Valley it is only 40 inches, and three miles further up the valley it is over 100 inches. Rainfall records, showing intensity of 4 inches per hour are frequent, highest rate recorded being 2·2 inches in 10 minutes. The 24-hour period extreme in 40 years of rainfall records are : 36 inches at Kilaueu, Kauai in January 1956 and 32 inches at Honomu, Hawaii in February, 1918.

**Natural Vegetation** : About one-half of the total area of Hawaii forms grazing land and another one-quarter is relatively idle forested land which is in forest reserves for watershed protection. Hawaii's native flora consists almost entirely of endemic species, varieties and form. The forests are stocked mainly with native Ohia ( Metrosideros polymorpha ) of little commercial value, and scattered stands of the highly prized Kau trees. The endemic flora also include Pritchardia macrocorpa, a beautiful palm, lovely species of tree ferns, interesting araliaceous trees, local gunneras, beautiful silverswords (Argyroxiphium Sandwicense), and the silvery geraniums of the highest slopes of 19,000-foot Haleakala Crater. Much of the endemic flora is being replaced by sugarcane, pineapple, macadamia, vegetables, exotic weeds and forest trees. Molasses, grass and other exotics are being sown from airplane, crowding out endemics, and in 1961 more than 100 acres of forest were bulldozed for planting pines, silk oak (Grevillea robusta) and monkey pod (Samanea saman). Faulty afforestation, as practised on the drier side of Oahu, also results in the decay of endemic flora,

**Soils** : Hawaiian soils are mainly derived from lava and volcanic ash, tuff and cinders, alluvial deposits and marine

The top photograph shows a beautiful spot in Oahu facing the Kaneohe Bay which can be reached from Honolulu through Wilson Tunnel. Paul L. Breese (Director, Honolulu Zoo) and Mrs. Breese, seen in the picture, played hosts to many a scientists attending the 10th Pacific Science Congress. The middle photograph shows a typical coast of Oahu with characteristic vegetation and horizontally bedded lava flows and volcanic ashes. Libbyville, a small town lies on a promontory. The bottom photograph shows the city of Honolulu extending eastwards over the low spurs of the Koolau Range formed of lava flows. In the foreground is the main canal of the city of Honolulu connected with the sea near Waikiki beach.



The top photograph shows a group of scientists attending the Science Congress standing on the Honolulu Watershed Forest Reserve of the Koolau Range and looking westwards toward the city of Honolulu. Waianae Mountains are in the background. The middle picture shows Diamond Head, an extinct volcano near Waikiki Beach dominating the landscape and the city of Honolulu. The bottom picture shows a group of scientists standing inside the crater of the Diamond Head.

sediments from coral reefs. Age and variety of parent materials plus extreme range of rainfall have resulted in complexity of soils that is hardly equalled in so limited an area anywhere else in world. Most of the soils are red earths, (latosols), characterized by the extreme depletions of silica and soluble bases such as calcium. Iron and aluminium have been concentrated throughout the solum because of the removal of bases and combined silica. Typically these soils have horizons which do not differ much in physical character, though having marked chemical differences. The colour of latosols is red due to the presence of the sesquioxide minerals. One physical property common to all these soils is the stability of the soil aggregates. They vary in size and feel like sand but break down under pressure. Practically all soils except those derived from corals are clays. This means that more than 40 per cent of soil weight is less than 0·002 mm. in size A chemical property common to all latosols is the ability to fix great quantities of phosphorous.

**Agriculture and Livestock Industry :** Agriculture has historically been Hawaii's bedrock industry. The total value of agricultural products in 1960 was 288.1 million dollars, of which 127.4 million dollars (44°2%) was derived from sugar, 118 milion dollars (41%) from pineapples, and 42.7 million (14.8%) from all other agricultural products. Besides sugar and pineapples, beef, milk, and eggs are the leading products. Coffee, which stood high in 1958 (6·5 million dollars) has declined sharply in value (to 3.5 million dollars in 1960) because of world overproduction. The agricultural economy of Hawaii, therefore, hinges on sugar and pineapples—the main users of labour materials and shipping. They provide the trade balance between exports and imports. Both are, however, subject to keen competition, sugar from sugar beet producers on the Main land and pineapples from all other canned fruit and juice products Sugarcane occupies 70.4 per cent of the arable land. Hawaii's sugar production is the highest in the world. In 1955 average production was the highest, 5.37 tons of raw sugar per acre on a 12-month basis. Since 1946 revolutionary changes have been made in plantations operations. Prior to 1946 labour was plentiful, relatively cheep and cane was harvested by hand. Cane tops and other residuals were left on the land and provided an effective mulch for open fields. As plantation labour came under union organisation, field operations were rapidly

mechanized to offset increasing labour costs. Bulldozers with shear blades were used to cut and windrow the cane after it had been defoliated by burning. Cranes with double-jawed cane grabs were used for leading the cut cane. Field railroad systems have almost entirely given way to fruits for hauling the cane to the mills. The mechanization of sugarcane cultivation created some new soil-management problems, as soil-protective features of the hand-harvested cane were largely lost. Sugarcane was irrigated by the 'closed' system in the past. Ditches made a herring-bone pattern with 'feeder' or head ditches on two sides of the field. 'Long line' system is being installed in recent years using aluminium flumes. Pineapples occupy about a quarter of cultivated land. In 1955-56 Hawaii produced 75 per cent of the world's canned pineapple products. The pineapple pack in that year was 18.5 million cases of fruit. The pineapples usually occupy land where the water supply is not adequate for the production of sugarcane, although on some plantations sugarcane and pineapples are also grown in a rotation system. The pineapple industry is highly mechanised. Fields are rather uniformly 100-300 ft. wide, permitting use of equipment having 50-65-foot booms, attached to one or both sides of a truck or tractor. Spraying for insects, and plant diseases, fertilizing, irrigating and harvesting are done with various adaptations of boom equipment, The largest pineapple cannery in the world is located in Honolulu to process pineapples.

Papaya orchards on small farms are another important cash crop. Rice, cotton, sisal, tobacco and a number of other staple crop plants have been grown successfully in Hawaii. They failed, however, to attain a competitive position because of high production costs. Crops that appear to have promise are : *Koa haole* as a substittue for high protein supplements being imported, litchi, ti, cherimoyas and other fruits of the family Annonaceae, Vanilla, sandalwood, lauhala products, taro, bananas, oranges, longan, mangosteen, mango, cacao, citrus, acerola and pepper. Ti plants (*Cordyline terminalis*) deserve special mention, as ti leaves are used for many purposes, The true Hawaiian 'grass' skirt is made of ti leaves. The large leaves are used at the luau for table cloths, plates and food wrappers, and the tender, young leaves serve as a kind of 'spinach' cooked with meat inside of large ti leaves. Liquor from the boiled root is fermented and distilled to make a fine drink.

In 1956 there were 156,800 head of beef-cattle, 12570 mature dairy cows, 11,700 sheep and 71,510 hogs. Beef and veal consumption was 39 million pounds of which 57 per cent came from the islands. Some of the larger ranches have their own slaughter houses. Average amount of milk per cow per day was 10.5 quarts and total milk from local product was about 47 million quarts. Large quantities of butter, butterfat, cheese and canned and dried milk had to be imported to supply consumer's need. In 1956 there were 356 commercial swine producers. Some 17 million pounds of pork was consumed of which 59% was of Island origin.

**Landuse Patterns and Trends :** More than one-half of class A land of Hawaii State, that is, land best suited for growing sugarcane, pineapples and fruits, and about 13 percent of B class land. that is land moderately suited for intensive agriculture is on Oahu island. It should be remembered that this embraces only 10 percent of the total land area of the State of Hawaii but contains about 80 per cent of the States population. In Oahu class A land measuring 67,820 acres lies mainly in the central valley between the two mountain ranges, class B land, measuring 30,750 acres lies mainly along the coast. The remaining three-fourths of the land area of Oahu has been classificd as C and D types, good enough for grazing, forest reserves and military installations. Over the past thirty years, landuse changes have occurred along two major lines : a continual decrease in area used for grazing and a continual increase in areas for urban and military use. The area in forest reserves increased substantially between 1920 and 1930 but has remained essentially constant since then. The justification of treating all agricultural lands of Oahu as potential urban and industrial sites has been recently challenged by land experts, and the problems of conflicting uses for agricultual land and the necessity of shifting the land to non-agricultural uses are becoming very acute at the present moment. Molokai possesses the potential for substantial agricultural expansion, and as it is nearest to Oahu, this island offers the opportunity of relief for some of the landuse problems of Oahu. Of Molokai's total area of 167,015 acres, about three-fifths is used for grazing. Pineapple production occupies 16,268 acres, or about 10 per cent of Molokai's total land area, Vegetables, alfalfa and orchards occupy less than one per cent of the land. From the present landuse point of view, this Island can be

divided into four regions : (i) West Molokai-Maunaloa ; (ii) Hoolehua Plains ; (iii) East Molokai ; (iv) Kalauppa Peninsula. Much of West Molokai is well-suited to mechanical agriculture, but pineapple is the only cultivated crop presently adapted to the limited rainfall condition of the area. The Hoolehua Plains region is well suited to intensive agriculture because it embraces large blocks of deep, fertile and relatively stone-free soils. Again, limited rainfall, without irrigation, and wind problems dictate that the present use of this land be limited to pineapple production. East Molokai is a region of diverse physical conditions. The narrow coastal plains are suited to the production of diversified crops and good pastures. Between the plains and the summit, the land is suited to grazing and water-shed use. The summit and east dome regions are adapted to commercial timber production as well as recreational and water-shed uses. Kalauppa Peninsula is suited primarily for grazing, with small areas in vegetables and watershed uses. The potential for changing agricultural landuse on Molokai is tremendous. Key elements in ascertaining this potential are development of an adequate supply of reasonably priced irrigation water and establishment of windbreaks.

Agricultural productivity of Maui is concentrated in the central fertile valley, which hardly covers 10 per cent of the total land area of the Island. Sugarcane and pineapples are important crops as in other islands. Outside of this central valley sugarcane producing land occurs near Kaanapali on the west coast. Another 40 per cent of Maui's land is pasture, which occurs mainly to the south of the central valley and also in narrow strips around the coast. The rest of the Island is mountainous with scenic attractions, and is being developed as a travel centre.

Kauai, the northernmost island of the group is dominated in the middle by rugged mountains and deep canyons which cover about two-thirds of the entire area of the island. This is the least productive part. It is only around four-fifths of the island's coastline that some agricultural acitivities are to be seen ; the production and growing of sugar and pineapples, truckfarming and ranching. The southernmost island of the state is named Hawaii or the Big Island It is twice the area of all other islands combined, though it contains hardly one-tenth of the total population. The Big Island leads in the production of sugar, beef, papaya, macadamia nut and flowers.

It is the only producer of coffee in the State, and is second only to Oahu in tourism. The sugar plantations extend north and south of Hilo along the east coast. The latest trends in landuse consist of the growing of macadamia nut south of Hilo and papaya in the Puna district. In the northwestern sector is the Parker Ranch (with headquarters in the town of Waimea), the largest producer of beef in Hawaii and the second largest ranch in the United States. Other ranches are scattered throughout the island on the mountain slopes. Farther south, on the slopes above the west coast, lies the centre of Hawaii's coffee industry.

**Minerals and Industries :** Hawaii is poor in minerals. Its bauxite deposits and titanium ores are yet to be developed. There are a few limestone quarries. Manufacturing industry is being developed. In 1960 a 65-million dollar oil refinery, and two large cement plants were set up. A large number of smaller industrial plants, based primarily on the imported raw materials, have also been set up in recent years. The value of manufactured and processed products (excluding sugar and pineapples) totalled 148.7 million dollars in 1960. Since much of this is based on imported raw matertials, however, the value to the Hawaiian econmy is estimated at 79 million dollars. Most of the manufacturing and commerce of Hawaii is in or near Honolulu.

**Trade and Transport :** Retail sales in Hawaii rose fro 462.6 million dollars in 1950 to 858.6 million dollars in 1960. Retail sales come to a seasonal high in July and August due largely to the seasonally high employment and tourist trade at that time. Overseas trade is of basic importance. Two-thirds of the income and employment in Hawaii is based on the inflow of 'mainland dollars' that are derived from commodity export and from invisible exports. Since world war II, invisible, exports (primarily in the form of goods and services sold in Hawaii to tourists, to the armed forces and to shipping and air lines) have considerably exceeded the value of commodity exports. Tourist expenditure rose from 6 millon dollars in 1946, to 24 millon dollars in 1950 and to 131 million dollars in 1960. Tourist trade thus has recorded the most rapid postwar growth of any major economic activity of the State. Prior to 1945, defence activity was of minor importance to business in Hawaii. During world war II, however, it completely dominated the economy and rose to a level of over 800 million dollars

annually. The outward evidence of the importance of defence in Hawaii is the system of highways between Honolulu and the primary military installation—the widest and most heavily travelled in the State. Transportation is the 'lifeline' of the economy of Hawaii, The volume and character of the various types of transportation serving Hawaii directly reflect the pattern of economic activity. Without efficient ocean freighters to Mainland markets (in which island exports are sold and from which Hawaii brings annually more than half a billion dollars of all types of commerce and producr goods) it would be impossible to achieve the economic specialisation necessary to maintain Hawaii's streamlined economy. And without the rapid expansion of airlines, the rise in tourism to present high levels could not have been achieved. All inter-island passenger traffic is by air, the most distant part being only one hour from Honolulu.

**Population and Settlements** : The estimated population of Hawaii on January 1, 1961 was 659,989 including military personnel and visitors. The area of Hawaii being 6,435 sq miles, the average density of population per sq mile comes to a little over 100. Its population is a mixture of Oriental, Occidental and Polynesian peoples. As a racial entity the Hawaiian people are nearly obliterated, their blood lines are adulterated, their strength and numbers wasted by the European diseases. A Hawaiian homestead for relatively pure-blooded Hawaiians has been set up by the Government at Waimanalo, a suburb of Honolulu. About one-third of the population of Hawaii are Japanese by race. Most of them are engaged in market gardening. The number of Caucasians is about the same as that of the Japanese. The Chinese, the smallest group, control commercial houses and are the richest people of Hawaii. Okinawans raise pigs and run restaurants. Portuguese settlers are mostly mechanics and contractors. The Indian business talent is represented by the Watumalls, who have established a Foundation for furthering the cause of education and culture. Filipinos are about twice as many as Chinese. Most of them are engaged in retail trade. For the past three decades, the growth of Hawaii State has centred in Oahu, which contains 80 per cent of the total state population. Between 1930 and 1960 the aggregate population of the Hawaiian islands minus Oahu declined by 20 per cent, whereas the population of Oahu increased by 147 per cent.

This has been due to the rise of suburban communities, including the Kaneohe-Lanikai-Kailua complex of Windward Oahu, and the continued expansion of harbour facilities, the construction of the new Honolulu International Airport, thc rapid growth of manufacturing and the continued development of new military installations. More than one-half of the State's population is in the only town of Oahu, Honolulu, which owes its phenomenal growth due to Waikiki's great attraction as travel centre, a marked peacetime increase in defence activity, the expansion and diversification of manufacturing and the rapid growth in shipping and airline.

Molokai's population and business activity are small and generally concentrated in Kauna Kakai, the principal town and port. Lesser centres of population and commerce activity include Kualapuw, Maunaloa and the Hoolehua District. Maui is dominated by a heavily populated central valley, the two major cities, Kahului and Wailuku containing one-third of the total population. The most significant new developmcnt, however is outside of this Central Valley. This is the Kaanapali Beach resort on the northwest coast above Lahaina, which is as large as Waikiki. Because of its excellent beach, scenic attractions, recreational functions, sunny weather, and its central location in the chain of islands, Kaanapali appears to have the potential for eventually becoming a major central Hawaiian resort.

Since 1922 Lanai is being developed. It now contains 2,115 people. Although it possesscs excellent hunting, fishing and recreational attractions, very few tourists include Lanai in their itinerary. Long-range plans, however, have been recently announced for creating a resort for sportsmen in Lanai city (pop. 2,056). The population of Kauai, numbering some 28,176 is doted along the primary highways in towns and cummunities extending around four-fifths of the island's coast line.

Hawaii contains a population of 61,322, too few for its area and resources and, therefore, possesses a great potential for population growth, Hilo is the second largest port in the State, exporting sugar, flowers and foliage, papaya and macademia nuts, Tourism is the most significant prospective growth factor at present. The centres of tourist interest in the Big Island are (i) the scenic, historic, and recreational atttactions including hunting and deep sea fishing of the Kona district ; (ii) the productive activities, the tropical flowers, and the scenic attrac-

tions of Hilo ; and (iii) thc interesting volcanic area of the southeastern sector including the chain of craters and volcano National Park. Prospective growth of population is indicated by recently announced projects, including the Laurence Rockfeller development on the northwest coast to the south of Kawaihae harbour, additional developments in Kailua and along the Kona coast, the construction of highways leading to volcanic areas, and the continued expansion of tourist facilties in Hilo.*

* In preparing this geographical account the author has drawn freely from the following publications :—

1. Pacific Discovery, Hawaii, September-October, 1951. Vol. XIV, No. 5.
2. Hawaii, July, 1951 published by bank of Hawaii.
3. Improving Hawaiian Soil Resources by U. S. Dept. of Agriculture, July 1958.
4. Oahu's land situation, published by Land Study Bureau, University of Hawaii. Nov. 1959.
5. Oahu : Lands Suitable for Intensive Agriculture & Other Uses on the Island of Oahu, University of Hawaii, publication, August 1959.
6. Molokai : Present and Potential Land Use by H. L. Baker, University of Hawaii, August 1960.
7. A Productivity Classification of Hawaii's Agricultural Lands by E. T. Murabayashi and F. K. Nunns, August, 1961.

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## Tenth Pacific Science Congress, 1961

The Tenth Pacific Science Congress of the Pacific Science Association was held in Honolulu, Hawaii from August 21 to September 6, 1961 under the presidentship of Dr. Laurence H. Snyder. Some 2,000 scientists from all over the world attended the Congress, giving a clear demonstration of the unity of scientific thought and problems throughout the world. After the Opening Plenary Session, the Congress was divided into nine sections :—I. Agricultural Science ; II. Anthropology and Social Sciences ; III. Biological Science ; IV. Conservation ; V. Forestry ; VI. Geography ; VII. Geophysical Sciences ; VIII. Public Health & Medical Sciences ; and IX. Scientific Information. Each of the sections was further subdivided into a number of divisions. For example, the section of agricultural sciences had three divisions. (1) Animal Science, (2) Crop Science, and (3) Soil Science. Two of the Commissions of the International Geographical Union on the World Land Use Survey and on the Humid Tropics also held their meetings during the


Delegates to the 10th Pacific Science Congress, Hawaii.

Congress session. The field trips organised in the Oahu and Hawaii islands were of special interest to geographers attending the Congress. The scientific sections had organised a number of symposia which were more highlighted than the sectional meetings for reading contributed papers. Seven symposia were organised for the geography section and over 30 papers on Cartography, Physical, Human and Regional Geography were taken up for reading and discussion in sectional meetings. The papers on Cartography ranged from correlation of gravity anomalies with crustal parameters' to 'Cartography for planning.' Physical and Regional Geography did not receive sufficient attention, and Human Geography included mostly papers on the 'Economic Geography of Japan.' A brief account of the papers relating to the seven symposia are given below.

**Symposium on the development of the Pacific Map**

Herman R. Friis, in his remarks as Chairman of the Symposium, said that development of the Pacific map was a a continuous process reflecting the products of geographical exploration and of surveying and mapping through time, and that in the development of the Pacific map many nations and many people have played an important role in furthering man's knowledge of this vast area by the cartographic medium. The development of the Pacific map, according to him, could be divided into three principal periods : (1) discovery and exploration by peoples indigenous to the Pacific Basin ; (2) the period of discoveries, mainly by European nations, 1500-1850 ; and (3) detailed large scale scientific surveying and mapping of selected areas since 1850. As to the first period, Gordon R. Lewthwaite threw considerable light on the pre-European navigations of the Pacific by the Micronesians, Polynesians and Melanesians, and maintained that it was only as a result of deliberate expeditions equipped with animals and delicate food plants by the early pre-European navigators, that the newly formed volcanic islands like Hawaii could be converted into a human habitat. Chiao-Min Hsieh dealt with the Chinese and Japanese explorations of the Pacific. The Chinese had organised many marine expeditions in the Pacific in the fifteenth century and collected detailed information about the sea routes and the products and customs of the people inhabiting the Pacific realm with the help of coastal maps, junks, marine compass and carrier pigeons. Japan started a little later, and by the end of

the sixteenth century traded with countries along the western Pacific, establishing colonies in the Philippines, Annam, Thailand and Java.

Of the European nations, France, unlike Spain and Netherlands, did not settle on the shores of the Pacific following the period of major discoveries, and, therefore, became interested in the exploration of the Pacific some what later. Robert Garry spoke on the 'French Exploration in the Pacific', referring first to the discovery of several islands in West Pacific by Bougainville from 1766 to 1769, and then to the geographical survey of the coast line carried out by La Perouse, who was the first to make use of the marine chronometer for measuring longitude at sea. Admiral D'Entrecasteaux was the next French navigator, who explored the West Pacific, Tasmania, and especially the archipelago of the Tonga islands. Garry next referred to the Baudin expedition, which was carried out from 1800 to 1803 and succeeded in drawing accurate maps of the West Pacific in general, Australian coasts in particular, and in bringing back to France geographical and anthropological documents relating to the Pacific countries. De Freycinet Duperrey, Dumont D'Urville, and Petit Thouars contributed much in later periods in furthering the knowledge of the Pacific in the fields of geography and hydrography as well as in natural and human sciences.

Kenneth Bartrand contributed a paper on American Exploration, 1783-1899, referring first to the United States Exploring Expedition, 1838-1842: commanded by Lt. Charles Wilkes. This expedition discovered and charted about 1300 miles of the Antarctic coast part of it bordering the Pacific Basin and surveyed about 280 islands in the South and Central pacific and several hundred miles of coastline from Puget Sound to San Francisco Bay. He next referred to the preparation of detailed charts of Japan and the Bering Sea and Straits as a result of the North Pacific Survey Expedition led by Commander Cadwalader Ringgold and Lt. John Rodgers. It was during this period that wind and current charts were compiled by Lt. M. F. Mahry from data abstracted by hundreds of logbooks, and parts of the Pacific coast were surveyed by the coast and geodetic survey.

An account of the American exploration in the Pacific during the twentieth century was presented by Robert H. Randall (Jr). It is true that nothing more could be added to the general geography of the Pacific. But adequate surveys of the Pacific

coasts, islands and depths had yet to be done. The basic triangulation scheme was, therefore, undertaken and completed by the Americans by 1906, and coastal hydrographic and topographic survey operations were continued from California to Alaska and then to the Aleutian with a view to charting a safe great-circle passages from the Puget Sound area to the Orient. The U. S. had also undertaken in response to maritime commerce modern surveys through Panama, the Galpagos and parts of Columbia and Equador, and also carried out bathymetric charting with the help of the echo sounder. Successive U. S. expeditions to Antarctica have obtained air photographs of much of its Pacific Coast, but for want of geodetic control coastal charting could not be undertaken until astronomical observations of eclipses and occultations were obtaind and use could be made of trilateration with high-acccuracy air-to-ground rudders.

**Symposium on land Tenure in the Pacific :** To this symposiam Ron Crocombe, Maynard Neas, R. H. Regnault, and M.M. Townsend and R. Turpin contributed papers. Ron Crocombe had selected the Cook Islands for his study. One of the major problems in the islands is the increasing fragmentation of agricultural land due to the inheritence legislation which resulted in the doubling in each generation of the number of owners of any section of land, and even the Act of 1946, which was intended to give security of tenure for long-term crops like citrus, would not solve the problem satisfactorily. Maynard Neas dealt with the land tenure system in the Marshall Islands, which is based on a matrilineal inheritance pattern. The concept of land ownership was not clear as 'use rights' appeared to be of more importance than ownership. R. H. Regnault discussed land tenure in Fiji in his paper with reference to the Lands Commission and the granting of freehold land to settlers, present colony characteristics, and position in respect to freehold and crown land. The next paper was on land tenure problems in Malaita, British Solomn Islands Protectorate by M. M. Townsend Land was not owned in this island until the second world war, the head of the family being free to choose any plot of land for coconuts and other trees on a new area each year. But Post-war legislation recognised a growing demand for individual ownership by facilitating buying-out of minor rights in an area R. Turpin contributed a paper on 'land tenure problems in Gilbert and Ellice Islands.' The land in the islands was of little economic

value until the middle of the last century, when coconut oil was first exported. Continuation of modified customary tenure caused fragmentation and subdivision of lands, though new legislation enabled neglected lands to be purchased by the land hungry.

The **Symposium on Pacific Island Terraces ; Eustatic** ? It was well organised by J. Russell, and all the papers contributed for the symposium were printed in Zeitschrift fur Geomorphologie, N. F. Suppl, Bd. III, 1961. F. H. Bauer in his paper on terraces of Southern Australia referred mainly to higher terraces up to 400 feet, dating from earliest Pleistocene times. S. P. Chatterjee dealt with the 'fluctuations of sealevel around coasts of India during the Quaternary period. According to him, besides the principal terraces which appeared to be equivalents of those in the classical European chronology, there were atleast two other higher terraces, all these indicating differential movements of land, both of the mainland and in nearby islands. K. O. Emory in his paper on 'Submerged marine terraces and sediments' indicated that the terraces were better preserved on insular shelves where sediment sources were smaller. According to him, five or more submerged terraces probably represented temporary halts during the rise of sealevel after a maximum lowering during the Wisconsin glacial stage, though many of them could not be recognised due to crustal warping, deltaic loading and glacial rebound. The only exception was the shallowest terrace at about 20 metres which could be recognised at many places in the Pacific and in other oceans because of its youth and accessibility. The next paper was by Edmund Gill on 'the changes in the level of the sea relative to the land in Australia during the Quaternary era.' He referred princpally to two levels :—the 10-foot level, exhibiting little oxidation, poorly developed soils and little $CaCO_3$ concentration, and the 25-foot level, characterised by oxidised materials that go below present sea level, association with incised streams that extend below sea level, well-developed soil profiles, and advanced stages of $CaCO_3$ concentration in calcareous beds. Gill also detected caves and benches at 40 to 50 ft. in the neighbourhood of 70ft., and between 100-120 ft. J. N. Jennings dealt with 'Sealevel changes in King Island. Bass Strait, and determined the age of some of the terraces as over 33,760 years applying the Carbon-14 dating method. William G. McIntire dealt with three river mouth terraces of Pleistocene age in Mauritius, Based on his

study of above sealevel coral and aeolianite rocks, he concluded that there was no transgression of the sea during Recent times. Takamasa Nakano contributed a paper on 'Stands of sea level in the Kwanto Basin region in Central Japan', his main findings being that during Wurm glaciation, sea level was atleast 60 m lower and that it was 10 m higher 5,000 years ago. Norman D. Newell dealt with 'recent terraces of tropical limestone shores.' According to him, shore-line features in many parts of the tropical Western Atlantic indicate that sea level is just now near its highest stage since the Pleistocene and that radio isotope dates indicate that the drowned dunes are Pleistocene in age and their position near present sea level suggests that none is younger than the beginning of the last major subsidence of sealevel at the close of the Sangamon stage. He further observed that the existence of elevated Pleistocene coral reefs preserved in many places near present shores encouraged the conclusion that these reefs have suffered comparatively little planation since they were formed. Howard A. Powers observed in his paper on 'Terraces in the Aleutian Islands' that tundra-covered rock platforms and beach ridges two to three metres higher than equivalent features in process of formation were regarded as evidence of an emerged shoreline, formed after the last extensive glaciation of the Aleutian Islands. Francis P. Shepard while discussing the main results of the study of sealevels during the past 20,000 years, observed that the rise in sealevel during the past two millenia appeared to be rather well shown by a compilation of Carbon-14 dates on shells and peat formations that were deposited at or near sealevel in stable areas, and that the best information was provided by borings into the bays and collections from the shelf along the coast of Texas and from borings into coastal Holland. The rapid rise of sealevel from about −300 to about −20 ft. between 17,000 and 6,000 B. C. and then a slow rise continuing up to the present time, a probable stillstand for about 3,000 years, were his other observations. The slightly raised terraces of Hawaii were considered by him as representing earth movements, an idea supported by Carbon-14 dates from elevated reef shells. Harold T. Stearns discussed the various causes for eustasy in his paper on 'Eustatic shore line on Pacific Islands. He listed the following shore lines : +2, +5, +12, −180, −300±, +25, − 60±, + 45, + 70, + 95, − 300±, + 250±, + 325±, +375±, +560, +652±, +1200±, and −1200 to−1800 feet, and

observed that shore lines between about 300 feet above sealevel and 300 feet below sealevel were of glacio-eustatic origin, and that those at greater heights and greater depths were probably in part eustatic. Stearns further suggested that uplift of the continents at the end of the Pliocene induced glaciation, allowed the upper parts of the submarine canyons to have been cut by streams, and caused a rapid eustatic rise of the world's oceans amounting to atleast 560 feet and possibly 1,200 feet.

### Symposium on Peasant and Plantation Agriculture

Many Asian countries have a dual economy with, on the one hand, a peasantry still practising traditional techniques and on the other, a plantation system employing huge capital and labour and growing tea, coffee, rubber and coconut for export. The interaction between these two systems was dealt with in papers contributed for the symposium on 'Peasant and Plantation agriculture'. B. H. Farmer selected Ceylon for his study, emphasising first the characteristic features of Ceylon's economy such as (i) the extent to which tea, rubber, and coconuts dominate the export trade of the country ; (ii) the extent to which the export crops are produced on the estates owned by local people, quite apart from the numerous small holdings growing these crops ; (iii) the extent to which the peasant sector is permeated by the cash motive ; (iv) the extent to which the national economy results in higher living standards, higher rates of gross savings, larger proportions of non-agricultural workers ; (v) the strong regional contrasts within the country, especially between the dry zone, and wet zone, the latter producing almost all the export crops. The next point emphasised was the marked differences (a) between plantation and small-holding yields of export crops and (b) between the value per acre and per operative of yields from plantations and from traditional rice-growing peasant holdings. According to Farmer, the present trend in Ceylon is in favour of the plantation agriculture and hence emphasis has been given to the development of the estates so as to increase the export trade in the recent Ten-Year Plan. C.J. Robertson contributed a paper on the interaction of plantation agriculture in economic planning with special reference to Southeast Asia which supplies three-quarters of the coconut products, two-fifths of the tea and a third of the palm oil. He compared the old plantation system, which was static in a dynamic and expanding society with the new

plantation system, characterised by its dynamic character and several lines of evolution, and concluded that 'political and emotional pressures against the plantation as an exotic cultural phenomena should not be allowed to divert efforts from it as a system for getting the best results from crops to which these countries are emimently suited.'

Iso Reksohadiprodjo in his paper dealt with the competition and co-operarion between small-holdings and Western enterpreneurs in growing export crops in Indonesia before and after world war II. Tom Harrison in his paper on 'peasant plantation relationships and economic development in Borneo, 1960' analysed the scale and methods of land holding by outside economic interests in North Borneo and Sarawak. Telesforo W. Luna Jr. selected Basilan Island occupying southern part of the Philippines, and dealt with the problems relating to the two major competing landholding activities, plantation and peasant agriculture. R.F. Watters in his paper traced the causes of the decline of the plantations as a land use system in Fiji, and the rise of a new system, 'Indian small holding,' which represented a fusion of productive arrangements derived from the plantation with persistent peasant qualities.

**Symposium on 'Pleistocene and Post-Pleistocene Climatic variations in the Pacific Area'.** H. Arakawa (Japan) made a systematic study of the blooming dates of the cherry blossoms at Kyoto (since the 9th century), freezing dates of Lake Suva (since 1943), and dates of first snow-covering of Tokyo ( since 1632) and concluded that the period 11th to 16th century, was colder than the modern or earlier centuries. Maxwell Gage discussed in his paper the Pleistocene and Post-Pleistocene climatic variations in New Zealand. He traced first the glacial history, and then dealt with the characteristics of New Zealand Pleistocene climates, and also referred to the 9th century 'Little Ice Age' in New Zealand. V. Auer selected Fuego-Patagonia for study, and concluded that the first Inter-glacial at about 41,000 B.P. represented conditions somewhat more humid than today and that the third inter-glacial was humid and cool, and that volcanism was associated with the inter-glacials but not the glacials. The first glacial period was most extensive and the last was least extensive. Auer's post-Pleistocene chronology, indicated that there have been alternating humid and dry periods since the Pleistocene, though there appeared to be no significant change

in climatic conditions during the past fifty years except that heavy rains (cloud-bursts) became more common in most recent decade.

Calvin J. Heusser discussed the Pleistocene climate variations in the Cordilleran region of the United States, reconstructing past climates from palaeobotanical, palaeozoological, palynological, glacial and geological evidence. The Pleistocene stratigraphic record from western Washington indicated five glaciations separated by nonglacial intervals. In Sierra Nevada, former glaciations were recognised and that the number of glaciations in the Rocky Mountains and other parts of the Cordillera was variable, but on the average found to be three. Heusser made a comparison of the present and past distribution of digger pine (*Pinus sabiniana*) which suggested that average winter temperature rose 5° C, and referred to pluvial studies at Searles Lake, California, dating two pluvials from before 46,000 to 23,000 B.P. and from 23,000 to 19,000 B.P.

Thor N.V. Karlstorm in his paper on climatic variation in Alaska and Western Canada, referred first to the following points based on the synthesis of glacial, sea level, ocean-temperature, pluvial, loess and pollen data : (i) widespread, if not global, palaeoclimatic and glacial synchronism and cyclicity ; (2) utility of radiocarbon and $Pa^{231}/Th^{230}$ but not as yet potassium/argon dating methods for Quaternary correlations ; and (3) functional validity of the traditional approach to Pleistocene classification based primarily on regional mapping of drift deposits in heavily glaciated areas according to type locality procedures ; and then made general observations as follows : (i) subdivision of the Pleistocene continental glacial sequence into atleast five glaciations rather than the traditional fourfold subdivisions ; (ii) about 300,000 not 600,000 or more, years duration for this continental glacial record ; (iii) dating of the pre-Naptowne (pre-Wisconsin) interglacial *ca.* 45,000 B.C., not earlier as inferred by some from pollen and ocean temperature data ; (iv) downgrading of the much discussed Two Creeks (Allerod) warm interval from the major to an important but distinctly subordinate climatic event in late-glacial time ; (v) geologic dating of the post-glacial maximum warmth/dryness (altithermal culmination *ca.* 3,500 B.C., not 500 B.C.) as implied by the palynologically defined 'Hypsithermal' ; and (vi) subdivision of the Alaskan glaciation (Recent) into recurring intervals of cooler and wetter climate during both sub-Boreal and sub-Atlantic times, and with maxi-

mum extension of post-Pleistocene ice and lowest sealevels dating *ca.* 2,000 B.C., not *ca.* 1,700 A.D. as has been inferred from some tree-ring dated moraines.

The paper on 'Quaternary Climatic variations in Antarctica as suggested by glacier fluctuations' was presented by Troy L. Pewe. Some of his conclusions are that (1) the ice sheet and other glaciers were more extensive—a time of 'glacier flooding' when the glaciers stood as much as 1,000 to 2,000 ft. higher than now ; (2) subsequent to this 'glacier flooding' the climate changed to permit lowering and withdrawal of the glaciers ; and for atleast the past 6,000 years the glaciers have been retreating, the result of warming of climate or diminution of precipitation. Bruno E. Sabels carried out trace element analysis in his studies of the climatic variations in the tropical Pacific, and demonstrated that manganese played the part of a climatic indicator in fossil cultural layers owing to its changing availability in soil solutions under different climatic conditions. The rule that manganese-poor beds indicate a dry climate' was checked against pollen evidence and carbon dates from an Arizona cave and carbon-dated cave strata from Iraq, Colorado and Nevada. The Niah cave profile revealed a major climatic fluctuation during the history of its occupancy, leading from subtropical conditions (1400 ppm manganese, pH 7.6) to tropical conditions (2,000 ppm manganese, pH. 7.4). Chester K. Wentworth studied evidences of past glaciation such as striated ledges, striated and erratic boulders, a heavy tillite with facetted and striated boulders on Mauna Kea (13,796 ft.) in Hawaii notably in the 10,500 to 11,000 feet zone, but also lower down at 7,000 ft., and observed that a 1,000-foot lowering of the snow line or a lowering of the tempe-rature by less than 5°F would bring glaciation on Mauna Kea again.

**Symposium on river regimes and flood problems** : The observations made in this Symposium are of special significance for India. Edward A. Ackerman dealt with water development (that is, the matching of water supply to existing or potential demand for water) in the light of modern science and technology. He observed that operation analysis, construction of consumption models, prognostic hydrology, design innovations economizing on materials, new construction methods and the use of nuclear explosives would bring about improved planning, design, construction and operation of systems of multi-purpose works. Ackerman further observed that geophysical prospecting and

improved methods of lifting groundwater would lead to the exploitation of new water supplies and that recycling, water-conserving agronomy, forest management for water yield, evaporation suppression and publicly controlled land use would bring about a reduction of water demand. As regards the fuller use of waters having substandard quality, he suggested the treatment of organic and chemical wastes, desalting, sediment control and water-use priorities.

Ian Burton and Gilbert F. White in their paper distinguished some ten types of 'flood hazard area' of wide distribution based on the grouping of a number of criteria such as channel stability, ability of the stream to carry sediment, width of flood plain, slope of adjacent land, flood seasonality and flood frequency, concluded by saying that 'a substantial opportunity exists to profit by the experience of others in adjusting to the flood hazard if like situation can be recognised, so that lessons can be transferred across national and cultural boundaries. Masahiko Ohya in his paper attempted a correlation between the flood type and microtopography. He carried out a field survey of a number of river basins in Japan, such as the Naka in the east, the Kano and the Kiso in the central part and the Chiqugo and the Honmyo in the west and observed that in the same alluvial plain, the flood type, the depth of the stagnant water, its period of stagnation, the direction and velocity of the current, the erosion and deposition—varied remarkably according to its microtopography comprising the natural levee, the backmarsh and the delta. A study of microtopography of an area whould enable one to tell what kind of floods are to be expected there so that precautions could be taken in right time.

J. Ross Mackay in his paper on the regime and flooding behaviour of the Mackenzie river dealt with the northern portion of the river, a stretch of 1,700 km from Great Slave Lake to the Arctic Ocean, and traced the influence of the lake on the regime of the river immediately downstream from it in two ways, first by stabilising outflow, and then by serving as a sediment trap. Mackay further observed that the regime conditions in the Mackenzie delta (12,000 sq km), the principal area of settlement, were greatly influenced by freeze-up, break-up, ice jams causing floods and reversals of channel flow, and storm surges along the distal portion of the delta. Fumis Tada and Takamasa Nakano contributed a paper on the relation between land forms and high tide

caused by the Isewan typhoon on 26 September 1959. They found that the landform classification map prepared by Masahiko Ohya in 1956 was very useful for the identification of regions dangerously subject to inundation, and observed that the inundated regions covering 185 sq km were restricted to the delta plain or fields reclaimed on the delta plain during the last three hundred years from the sea floor, and that the high tide at 3.89 m above sea level jumped over the dikes along the coast and the rivers and invaded the paddy fields behind the dikes.

**Symposium on social and economic implications of mechanization of rice agriculture :** Three papers on mechanizations of rice agriculture in Japan were contributed by Japanese geographers. Yoshikatsu Ogasawara mentioned in his paper the critical factors of agricultural mechanization in Japan such as the price of rice and labour shortages in agricultural seasons. According to him, the rise of the official rice price since 1955 has greatly contributed to increasing the number of small tractors by a geometric ratio, and in 1960 the number reached 500,000, a six-fold increase in five years. There are two highly mechanized rice-growing regions in Japan : (1) the specialised paddy-field region on the Japan sea side, Southern Kochi having two rice harvests in the course of a year ; and (2) the region surrounding the Tokyo-Yokohama conurbation, where vegetables are raised as the second crop of double-cropped paddies. Keiji Kamya carried out a comparative study of 24 farms in the Nika rural community near the town of Takamatsu where a small type of power cultivator was introduced, and that of 16 farms in Mukaiba. a neighbouring community of the same town where use of draft animals still prevailed, and incorporated the findings of his study in his paper on 'Comparison between power cultivators and draft animals from the view point of business economy.' According to him, it was much cheaper to have land cultivated with the help of small power cultivators than with the help of draft animals (1,287 yen per tan (0.1 hectare) of land in mechanised agriculture and 3,240 yen in non-mechanised land), though the use of draft animals was found still more profitable under 2.5 cho (hectare) of tillable acreage a year. Yuzuru Okada investigated social effects of the mechanization of agriculture in Nika village, western Japan and found that the effects were on the whole very healthy, as mechanisation saved much farmwork and house-work and increased substantially the leisure time.

To solve the twin problems of increasing population and shortage of arable land, Taiwan concentrates one of its principal efforts upon the introduction of mechanised farming. This topic has been dealt with by Fengchow, C. MA in his paper on 'implications of rice field mechanisation in Taiwan.' The number of power tillers in use in Taiwan increased from 7 in 1954 to 3,708 by the end of 1960. According to Fengchow, rice farmers are the most enthusiastic group in accepting small-sized power tillers, manufactured in the U.S. and Japan as they can grow more crops (two rice crops and one winter crop in a year) and the increased yield resulting from mechanised deep ploughing has benefitted them with more economic returns. A number of hand tractors of different make were tried in Korea and eventually the Japanese Kubota machine was found most suitable for ploughing rice fields in Korea. F.R. Pitts in his paper traces the history of hand tractors in the Republic of Korea and mentions about the activities of the Agricultural Institute at Suwon in this connection. Outside Asia, rice is cultivated in Spain, Italy and the U.S.A. Richard K. Beardsley contributed a paper on rice field mechanisation in Eastern Spain. According to him, farm machinery is still very little used in Spain, except in the intensively irrigated rice land occurring along the Mediterranean Coast especially around Valencia and parts of the lower Ebro Valley. Beardsley also referred to a recent Valencian mechanisation (1945-1960) that has brought cultivator-owned tractors to the fields, which pull trailers and drag ploughs, harrows and other equipments.

Rice is Italy's third cereal crop and its position in the agricultural economy and as an export commodity is of the first rank, Slightly over 90 per cent of the rice crop is grown in the middle of the Po Valley, in Piedmont and Lombardy ; over 45 per cent is grown from transplanted seedlings. The operations of transplanting and weeding, both demanding a large input of labour are of crucial importance for the crop ; and hence the need for mechanisation of rice fields is keenly felt. George Kish dealt with implication of rice field mechanisation in Italy. According to Kish, harvesting is now largely mechanised and the problem ef mechanising weeding operations also appears to be solved, for such herbicides as 2-4, D and its derivations are strong and selective enough to keep paddies clean. Mechanisation of transplanting, on the other hand, is still in the experimental stage. In United States California grows rice in considerable

quantities. Cliffords H. MacFadden and James Bruinstlot studied economic consequences of rice production mechanisation in California and contributed a paper on this topic. They referred to a new rice region in California where more than a quarter of a million acres of former California wasteland have been transferred into exteremely profitable rice-producing land through mechanisation, giving higher yields and greater profits per acre than almost any rice-producing country in the world employing traditional hand methods of cultivation. Texas is another important rice-producing State in the U.S., having a little less than one-third of the total rice acreage of the U.S. George W. Hoffman contributed a paper on 'implications of rice field mechanisation in Texas,' describing first the topography, drainage, climate and soils of the rice belt which extends along the Gulf Coast from the Lousiana border west to the Bay of Lavaca, having a width of 75 miles. Hoffman then traces the history of mechanisation and how it gradually led to the increase of rice acreage from 178 acres in 1890 to 637,000 acres in 1954 and also to increased production and a lowering of production cost, and concludes by saying that the complete mechanisation has made it posaible for Texas rice growers to produce, on an acreage cost basis, more cheaply than oriental labour, utilising only hand methods.

**Symposium on Urbanisation in the Pacific Realm :** Jerome D. Fellmann in his paper on 'recent developments in American urban patterns' develops the theme that 'the highly compact "city" is giving way to the 'metropolitan district' in which there is an interpenetration of urban and non-urban uses, a wider dispersion of districts, and a softening of the traditional hierarchical structure of area of similar function. K. W. Robinson has made a comparative study of Australia, the most urbanised of all countries except the U. K., with 57 per cent of her people in cities of 100,000 or over and New Zealand, another highly urbanised country ; and contributed a paper on 'processes and patterns of urbanisation in Australia and New Zealand.' According to him, patterns of urban distribution show striking variations between the Australian states and between Australia and New Zealand. There were two papers on the urbansiation in Japan, one by Shinzo Kiuchi, and the other by Norton Ginsburg and Amiram Gonen. Shinzo Kiuchi first traced the population growth in Japan between 1955 and 1960 ( the latest census, October, 1960 reported that the Japanese

population was 93,406,803, an increase of 4,131,301 since 1955) and then dealt with causes of urbanisation. The centralization in three metropolitan areas : Tokyo, Osaka and Aichi (including Nagoya City) was found to be more marked in 1955-60 than in 1950-55 period. Shinzo Kiuchi concluded by saying that 'Japan is a semi-westernized country', her urbanisation has been promoted not only by her modern industrialization, but also by pushed-out population from villages. The areal development of Tokyo and Osaka may be similar to that of New York or London, but their structures and causes of urbanisation are different.' The paper by Ginsburg and Gonen examined some of the morphological and functional characteristics of the 'Hanshim Metropolitan Area' ( the Osaka-Kobe conurbation ) in some detail, discussed certain characteristics, both general and unique, of its growth process, and described some of the problems of the area which require intercity consultation, consideration and co-operation. S. G. Devis in his paper on the 'rural-urban migration in Hongkong refers to a new form of urbanisation, 'strips conurbations' in the harbour areas of Hongkong and traces the development of the city by spilling over into the country in recent years.

The open meeting of the Commission on World Land Use Survey, International Geographical Union, was presided over by the Commission Chairman, L. Dudley Stamp, and a number of geographers including J. Kostrowicki, Nafis Ahmed and S. P. Chatterjee spoke on the land use survey of their own countries. Gaussen exhibited a new type of floral map of a part of India and explained the technique adopted by him in drawing such a map. Kostrowicki referred to detailed land utilisation survey of Poland on the scale of 1: 10,000 and 1: 25,000 and said that Polish land utilisation survey distinguished a number of agricultural types differing in systems, intensity, direction and productivity of the rual economy. Nafis Ahmed exhibited a land use map of a small area in East Pakistan, that was prepared by his students. S. P. Chatterjee referred to the land use maps on the scale of 1:1M, which are being prepared by the National Atlas Organisation, Ministry of Scientifiic Research & Cultural Affairs, Government of India.

The Chairman reported on current work of the Commission and made a special reference to the state of work in progress in Canada, Hongkong, Italy and Britain (new Landuse survey) and to

collaboration with F. A. O. and UNESCO including publication of History of Landuse in Arid Lands (UNESCO). Published monographs on Hongkong, Cyprus, Tobago and Transvaal were presented at the meeting and manuscript maps of India, Pakistan, Singapore, West Africa, East Africa and Canada were displayed. J. Kostrowicki reported on work in Poland and Eastern Europe. S. P. Chatterjee (India), Nafis Ahmed (Pakistan), A. Watanabe (Japan), T. L. Hills (Carribbean), K.B. Cumberland (New Zealand and Samoa), H. C. Brookfield (Australia and S. W. Pacific), C. S. Chen (Taiwan), and R. G. Ward (Fiji) also spoke on the programme of landuse work in the countries noted against their names.

Of the papers read and discussed at the open meeting of the Special Commission of the Humid Tropics, two deserve special mention. B. J. Garnier in his paper defined a humid tropical month as 'one in which the mean temperature is 68°F ( 20°C) or over, mean vapour pressure is 20 mb. or more, and mean relative humidity is atleast 65 per cent,' and further said that for a tropical month to be ecologically humid tropics experience the required temperature conditions for six months of the year. The other paper was on 'the role of the geographer in resource and population mapping in an underdeloped area of the humid tropics' by Leo Peeters. According to the author, it is mainly in the humid tropics that the populations have fitted in their way of living with their natural geographical environment, and that accurate knowledge of the geographical environment and an understanding of the interaction between this environment and the economize-active man must necessarily be at the basis of any project for further economic development of thesc populations.

A number of reports of the Standing Committees on various subjects were presented to the Science Congress, of which the one on 'soil and land classification in the Pacific Area' had a special interest for geographers. Yutaka Kamoshita in his paper on 'soil and land classification in Japan' traced the progress of soil survey in his country since 1882, dealt with the various national projects of fundamental research concerning soil classification, and briefly referred to the principal soil types—zonal, intra-zonal and azonal ; and mentioned that the land utilisation survey was started by the National Conference on Researches of Agriculture, Forestry and Fishery as late as 1958.

Dr. J. K. Taylor in his paper traced the progress in soil and land classification in Australia, 1957-1961, and referred to the new soil maps of Australia on a scale of 1/2,000,000 in which soils have been classified into four main groups : (i) soils with uniform texture profiles ( 10 subgroups defined ), (ii) soils with gradational texture profiles (4 subgroups defined), (iii) Soils with contrasting texture profiles (120 subgroups defined), (iv) soils with organic profiles. The paper on 'soil survey in Indonesia' dealt with the present programme and progress of work which includes (i) the preparation of an exploratory soil map on the scale 1:1,000,000 to show the soil resources, problem areas and possible sites for development, covering 40 million hectares in Central Sumatra and West Kalimantan ; (ii) reeonaissance soil maps on the scale of 1:250,000 already covering a million hectares in the Island of Madura and the provinces in Central and East Java ; (iii) Key maps on scales ranging from 1:50,000 to 1:100,000 covering specific areas for economic land use and soil research experiments ; (iv) detailed soil maps on scales 1:5,000 to 1:25,000 for development projects. 13 soil groups have been recognised for the purpose of mapping. These are : latosols, andosols, red-yellow podzolic soils, red-yellow Mediterranean soils, regur soils, podzols, paddy soils, hydrosol, calsisols, regosols, lithosols, alluvial soils and organic soils.

Dr. Robert Ho in his paper on 'status of soil and land classification in Malaya', referred to the first published soil maps on the scale of 1:500,000 and report for the state of Trengganu, and stated that by 1965 the entire country would be covered by new soil maps on that scale. The land use survey was undertaken by the Department of Geography of the University of Malaya in co-operation with the Federal Town Planning Department and some 300 sq miles in the Klang Valley were completed. Papers on soil surveys in Canada, New Guinea, Philippines and Taiwan were also presented.

The paper on 'changing concepts and techniques in soil survey' by J. Kenneth Ablaiter was of special interest, as it reviewed the important changes that have been made in soil survey during the past forty years, and emphasised on the recognition of the soil profiles as expressing the genetic history of the soil and suggesting its possible behaviour, and also on the enlargement of the concept of the soil from the profile at a point to an area.

# URBANISATION IN MADHYA PRADESH

S. N. Mehrotra

The State of new Madhya Pradesh, as constituted on November 1,1956, comprises the erstwhile states of Madhya Bharat, Vindhya Pradesh, Bhopal and the Mahakoshal region of the old Madhya Pradesh. The State has a geographical location betwecn 18°N and 26° 30′N lat., and 74°E and 84° 30′E long. It has an area of 1,71,052 sq. miles and a population of 2,60,71,654 persons. Politicaly, it is the largest province ( with 43 districts ) in the country. Its peoples are roughly seven times as much rural as they are urban. It has a rich reserve of some very old and primitive types of tribes who abound in its 67,518 sq. miles of forested area.

From the point of view of physiography, the State embraces some of the most attractive relief features found in the country. One can observe in its landscape the grcen hills of Vindhyas and Satpuras, the low undulating plateau of Malwa, the fertile valleys of the Narmada and the Chambal, and the broad valley-plain of the Upper Mahanadi—the Chhattisgarh plain-virtually a rice-bowl of the State. It is drained by nearly a dozen important streams of which quite a few have very prominent agricultural and cultural heritage to their credit. In fact the Chambal, Sindh, Betwa and the Son are much older than even the Ganga and the Yamuna. The numrous lakes and 'tals' that stud its surface, the sparkling waterfalls that lend charm to its grandeur and the invisible reserves of valuable minerals that lie hidden in its bosom —all point towards its bright future.

Since there is a variety of relief and landscape in M.P. it is but natural that here one should be confronted with contrasts not only of physical geography, but of human geography as well. Owing to its neglected economy, this region has so far remained a backward area of our country. It has lacked in an all round industrial development and urban growth. Therefore, its people mostly lead a poor and rustic life even today and the number of large settlements with modern civic amenities are small.

In the more advanced countries of the world urbanisation has gone a long way in changing the cultural pattern of the landscape Whereas in the past natural features like mountains, lakes, rivers and junction of routes influenced urban development, today some new forces responsible for urban agglomeration are seen in the

rapid industrialisation and commercial expansion of states. Though having a very rich cultural past, India has not kept pace in urbanisation with the advanced western countries, much less so has the State of M.P, which occupies a very low place among the states of the Republic. The following table gives the trend of urbanisation in India over the last thirty years and the position of the state in this respect[1] :—

(A) **India**

| Year | Percentage of Population | |
|---|---|---|
| | Rural | Urban |
| 1921 | 88.7 | 11.3 |
| 1931 | 87.9 | 12,2 |
| 1941 | 86.1 | 13.9 |
| 1951 | 85.4 | 14.6 |

(B) **Position of the various States** (1951)

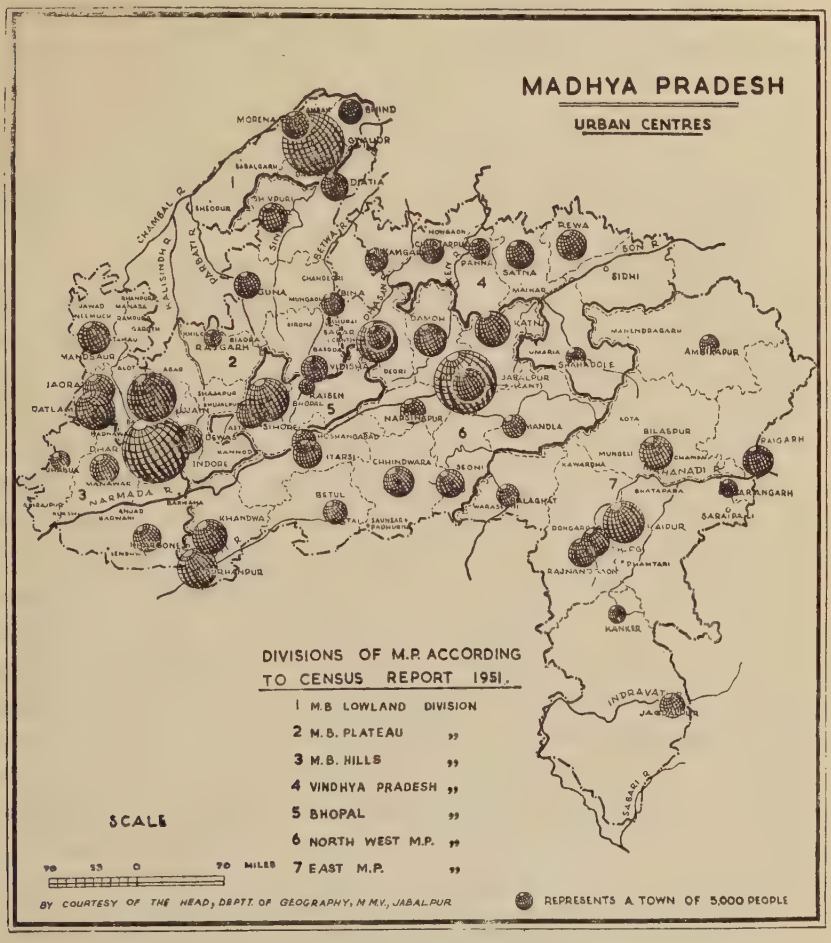
| *State* | *Urban percentage of population* |
|---|---|
| Delhi | 75.78 |
| Ajmer | 36.68 |
| Saurastra | 25.60 |
| Bombay | 23.92 |
| W. Bengal | 21.76 |
| Bhopal | 17.72 |
| Madhya Bharat | 15.32 |
| Old M.P. | 11.29 |
| Vindhya Pradesh | 5.49 |

It ia an old saying that cities are as ancient as civilization. In fact the chief characteristic of the European type of civilzation is the unmistakable shift from a rural to an urban way of life, The rise of civilization has been intimately bound up with the gathering of men to live in cities because the two phenomena have a common geographical basis.[1] The present article is an attempt to study urbanisation in M.P. in the recent past and to trace out the trends of population growth in the from of towns and cities.

It has been the general practice in this country to classify the urban settlements into towns and cities. But these terms have a quantitative significance. According to the Census of India a 'Town' generally means a collection of houses inhabited by not

1. Vishwanath, Dwivedi and Kanaujia, Manav Bhugolke Sidhant, 1956, pp. 162—63.

less than 5000 persons ; but many smaller settlements with less than 5000 persons have also been considered as towns in the 1951 Census because they possessed urban characteristics and also because each one of them had a local body functioning in it. A 'City' generally means an urban settlemnt of one lakh or more inhabitants. In 1951 there were 202 towns and cities of all classes in M.P. but about 35 of these had less than 5000 persons.[2] The distribution of these towns and citics will be clear by a glance at Map No. 1.




Map No. 1

**General distribution of Urban settlements** It is obvious from the map that distribution of towns in M.P. is irregular. There

1. Smailes, A.E., The Geography of Towns, 1953, p. 7.
2. M.P. Statistical Abstract, 1956-57, Table No. 3, pp. 6-9.

are certain regions which stand out as markedly more urban than the rest. As for example, the alluvial valleys of the Narmada and the Chambal are clearly more urbanised than the hilly regions on their two sides. The most urbanised part is that which lies between the rivers Chambal and Betwa, and is bounded on the south by the Vindhyan ranges. It contains a large number of towns and some of the biggest cities of the state. The cities of Gwalior, Ujjain, Bhopal and Indore, along with Ratlam, Mhow, Mandsaur, Dewas, Dhar and a number of small towns are all found in this region. The second important region is the great Narmada-Son trough where lies the city of Jabalpur, along with the Class II towns of Burhanpur, and Khandwa, and a number of smaller towns e.g. Jabalpur Cantt., Murware (Katni), Itarsi, Khargone etc. This is a valley formed of deep alluvial deposits of extreme richness and promises to be the lifebelt of whole M.P.

The third region of urbanisation lies in the eastern part of the state wherein the river Mahanadi, with its tributaries, has laid fertile tracts. The Chhattisgarh plain has only one big class II town of Raipur. Other important towns of this area are Bilaspur, Rajnandgaon, and Durg. The last named town is fast developing into a big centre because of the Bhilai Steel Plant nearby. The fourth region comprises the small basins of the Dhasan aud Ken rivers, where, excepting the Class II town of Saugor, one dose not see any other major town. The whole of Vindhya Pradesh has been a very backward region and it does not possess any city. Most of the urban centres of this area have populations of 20,000 or less. They can, therefore, be taken as Class III or Class IV towns or Class V sub-towns. Only Datia, Satna and Rewa are Class III towns of some significance. The ravines of the Chambal and the Sindh in the west and the highlands of Bundelkhand and Baghelkhand in the east have not offered any attractions for urban settlements of any importance.

A fifth region of towns, but no city, lies south of the Narmada valley amidst the ranges of the Satpuras, Mahadev and Maikal hills. It is obvious that the centres in this hilly and forested region could depend for their growth only on forests or mines. Almost similar are the conditions north of the Narmada where urbanisation is hardly perceptible in the hilly tracts of the Vindhyas, Bhanner and Kaimur ranges, Almost all districts lying

in this region do not possess more than 2 or 3 towns each that serve as collecting centres for the produce of the environment. It is worth noting that means of transport and communication are also lacking here. In most cases one out of these 2 or 3 towns in each district has a population between 5000 to 10,000 persons only e.g. Kannod (5610), Astha (6234), Begumganj (6617), Maihar (9397).[1]

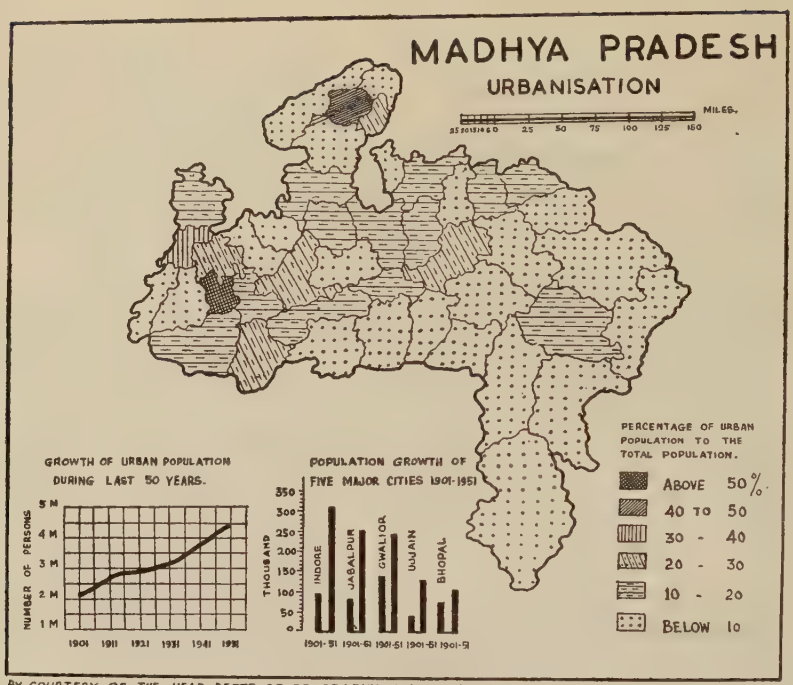
**Growth of Urban Population :** The trend of urbanisation in this State has been rather very halting and slow, though there has been marked and quite significant rise in the total population. The following table clearly brings out this characteristic :—

| Year | No. of towns | No. of Villages | Total Population | Urban Population |
|---|---|---|---|---|
| 1901 | 104 | 65740 | 16,976,318 | 1,501,644 |
| 1951 | 202 | 70038 | 26,071,654 | 3,132,945 |

Urban percentage to total population in 1901 was 8.8% ; in 1951 it rose to 11.5% only. However, prior to 1901 and between 1881 and 1901 Central India Agency had recorded a rise of 18% in the urban populstion due to chiefly the opening of new railways and consequent increase of commerce.[1] The former Central Provinces had recorded an increase of 29% in the urban population during these decades. This was mainly attributed to the growth of factories and other urban industries, the expansion of rail-borne traffic, the spread of education and with the formation of a wealthy and educated class in society who preferred town life.

During the last half a century the State has shown a continuous growth of urban population. (See Map No. 2) Since 1901 the number of towns has gone up by 98 and that of villages by 3298. It is very significant that whereas the total population of 1951 showed an increase of only 53% over that of 1901, the urban was more than doubled in the same period and represented nearly 1/8 of the total population. Thus, in 1951 there were 2.7% more people living in urban centres than in 1901. But it is to be remembered that most of these urban centres are Class IV or V towns with less than 20,000 persons. The number of cities has not increased very much.

1. Ibid, Table 4, pp. 12-13.




BY COURTESY OF THE HEAD, DEPTT. OF GEOGRAPHY, M.M.V., JABALPUR

Map No. 2

**The Cities :** The following table gives the variation in population of cities in M.P. since 1901 :—(See Map No. 2)

| City/Year (1) | Total Population (2) | Meen decennial growth rate (3) |
|---|---|---|
| **Indore** | | |
| 1901 | 99,880 | — — |
| 1911 | 57,285 | −54.2 |
| 1921 | 107,948 | +61.3 |
| 1931 | 147,100 | +30.7 |
| 1941 | 203,698 | +32.3 |
| 1951 | 310,859 | +41.7 |
| **Jabalpur** | | |
| 1901 | 90,533 | — — |
| 1911 | 100,651 | +10.6 |
| 1921 | 108,793 | + 7.8 |
| 1931 | 124,382 | +13.4 |
| 1941 | 178,339 | +35.6 |
| 1951 | 256,998 | +36.1 |

1. Imperial Gazatteer Vol. IX p. 340
2. Ibid Vol. V p. 20

| (1) | (2) | (3) |
|---|---|---|
| **Gwalior** | | |
| 1901 | 138,575 | — — |
| 1911 | 84,458 | −48.5 |
| 1921 | 113,684 | +29.5 |
| 1931 | 126,949 | +11.0 |
| 1941 | 182,492 | +35.9 |
| 1951 | 241,577 | +27.9 |
| **Ujjain** | | |
| 1901 | 39,892 | — — |
| 1911 | 39,295 | −1.5 |
| 1921 | 43,908 | +11.1 |
| 1931 | 54,650 | +21.8 |
| 1941 | 81,272 | +39.2 |
| 1951 | 129,817 | +46.0 |
| **Bhopal** | | |
| 1901 | 77,023 | — — |
| 1911 | 56,203 | −39.0 |
| 1921 | 45,094 | —24.3 |
| 1931 | 61,037 | +35.2 |
| 1941 | 75,228 | +27.1 |
| 1951 | 102,333 | +30.5 |

The salient point which emerges out of an analysis of the [1] above table is that the State had only one city in 1901, i. e. Gwalior. The second city to grow up was Jabalpur in 1911, but by this time the population of Gwalior had decreased so much as to revert it to the position of a Class II town. In the next decade only two more cities were added—Indore with its population rising to 107,948 and Gwalior regaining its lost position by its population jumping on to the figure of 113,684. The other two cities—Ujjain and Bhopal—have developed to the rank of a city only in 1951. With such a vast area and quite a large population it is not a good record for this State to have only 5 cities within its bounds.

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1. Statistical Abstract of Madhya Pradesh, 1956-57, Table No. 6, p. 15.

Note: In this article classes of towns have been determined on the following basis :—

Class I town or City : 100,000 or more people
„ II town : 50,000—100,000 „
Class III town : 20,000—50,000 people
„ IV „ : 10,000—20,000 „
„ V „ : 5,000—10,000 „

Munro had said that steel and credit had made the modern city possible. But in this State this statement may not be justly attributed to all the cities and towns. Only in the case of Indore and to a little extent Gwalior, can we say that the influence of industrialisation over urban growth has been appreciable. The average urban settlement in the State is a commercial town usually with a historical background and often now supported by administrative and social centralisation. The most urbanised Division and District of the State is Indore and the most un-urbanised is Bilaspur Divivison. The biggest district of the State —Bastar (area 15,091 sq. m.)—has an urban population of only 18,717 living in two small towns of Jagdalpur and Kanker.

**Variation of Population in natural divisions :** For the Census of 1951 the whole country was divided into Natural Regions, Sub-regions and Divisions. The State of M.P. came within the following Sub-regions and Divisions :

(A) Trans-Gangetic Plains Sub-region :
  (i) Madhya Bharat Lowland Division
(B) N. W. Hills Sub-region :
  (li) Madhya Bharat Plateau Division
  (iii) ,, ,, Hill ,,
(C) North Central Hills and Plateau Sub-region :
  (iv) Vindhya Pradesh Division
  (v) Bhopal Division
  (vi) N. W. Madhya Pradesh Division
(D) N. E. Plateau Sub-region :
  (vii) East Madhya Pradesh Division ( excepting Chanda district)

Is is intersting to make a detailed study of the trends of urbanisation in each of these seven Divisions. The former Madhya Bharat unit of M.P. is definitely the most urbanised part of the State. This becomes evident from the following table :

| Units | Town | Cities |
|---|---|---|
| Madhya Bharat | 64 | 3 |
| Mahakoshal | 66 | 1 |
| Vindhya Pradesh | 64 | — |
| Bhopal | 3 | 1 |

In Madhya Bharat urbanisation became conspicuous from 1921 onwards. It was from that time that the rural population began declining continuously. The greatest decrease has been noticed in the last decade 1941-1951. The 67 places recognised

as towns in 1951 Census reflect in their growth the history of the growth of urban population in the whole of this region. They have represented an increase of 102.1% in 30 years. In 1921 the number of towns of over 5000 population was 37 and these have since added about 106% to their population. The remaining 30 places with less than 2000 population in 1921 have since added about 80.5% only.

Among the Natural Divisions the Lowland Division has shown the largest percentage increase of 110 in its urban population since 1921, with the proportion urban increasing from 124 per mille to 184. The Hills Division, however, has shown the smallest percentage increase (43.1% only) over the same period, with the proportion urban increasing from 83 to 88. The corresponding figures for the Plateau are 109.8% and from 143 per mille to 214.[1]

(A) (i) **The M. B. Lowland Division** : This comprises the districts of Bhind, Gird and Morena. The following table brings out the percentage variation of population in these districts during the last two decades very cleary :

| District | 1931—41 | | | 1941—51 | | |
|---|---|---|---|---|---|---|
| | Total | Rural | Urban | Total | Rural | Urban |
| 1. Bhind | 14.8 | 14.4 | 25.2 | 6.6 | 6.3 | 20.4 |
| 2. Gird | 20.8 | 8.6 | 44.2 | 17.9 | 6.9 | 33.9 |
| 3. Morena | 13.4 | 12.1 | 42.4 | 10.3 | 9.4 | 25.8 |
| M. B. Lowland | 16.0 | 12.2 | 42.1 | 11.4 | 7.7 | 31.7 |

The city of Gwalior stands out as the most important city in this division. It owes its importance to the fact that it was part-time capital of M. B. and also headquarters of the former Gwalior State. It is the growth of the urban population in this city that has given Gird the highest percentage figures of urban population variation in 1931-51. However, it is to be noted that the history of growth of this city contains nothing striking like the rise of the industrial towns of Ujjain and Indore. There has doubtless been some industrial and commercial development during the last thirty years but the town is still largely a residential centre. In the recent past its woollen, silk and rayon factories along with the machine-tool factory for cotton mills have attracted large number of people to the urban area. Besides, the city has a number of other industries like Biscuit & Sweets, Leather, Potteries, Engineering and Handloom etc. which are all

1. Census of India 1951, Vol. XV Part I-A, p. 39.

bound to make Gwalior a growing industrial centre in the not very distant future.

The M. B. Lowland Division has recorded within the last thirty years an increase of 110.5% in its urban population, whereas the corresponding figure for rural population is only 32·6. That shows very clearly the rapid stride towards urbanisation.

(B) (ii) **The M. B. Plateau Division :** This comprises the ten districts of Shivpuri, Guna, Mandsaur, Rajgarh, Shajapur, Ujjain, Ratlam, Bhilsa, Indore and Dewas. The following table shows the percentage variation of population in this division :

| District | 1931—41 | | | 1941—51 | | |
|---|---|---|---|---|---|---|
| | Total | Rural | Urban | Total | Rural | Urban |
| 1. Shivpuri | 11.1 | 8.9 | 19.6 | 3.7 | 2.4 | 41.3 |
| 2. Guna | 12.I | 10.6 | 29,7 | 1.1 | −1.8 | 30.0 |
| 3, Bhilsa | 10.2 | 8.3 | 40.4 | −0.7 | −3.2 | 31.5 |
| 4. Rajgarh | 9.7 | 9.4 | 12.7 | 6.4 | 6.6 | 3.8 |
| 5. Shajapur | 12.6 | 11.3 | 34.1 | 6.1 | 4.5 | 28.3 |
| 6. Ujjain | 14.5 | 9.0 | 33.7 | 19.6 | 9.2 | 49.6 |
| 7. Dewas | 6.3 | 4.5 | 30.3 | 5.9 | 4.6 | 19.4 |
| 8. Mandsaur | 17.6 | 16.4 | 23.6 | 16.9 | 14.3 | 28.9 |
| 9. Indore | 19.4 | 6.4 | 33.2 | 32.3 | 13.6 | 48.3 |
| 10. Ratlam | 15.4 | 14.7 | 17.6 | 13.9 | 8.1 | 30.9 |
| M. B. Plateau | 13.1 | 10.4 | 28.2 | 11.2 | 5.6 | 37.7 |

The cities of Ujjain and Indore are located in this Division. Ujjain has been a Capital city from ancient times. It was the seat of Scindia's dominions till 1810. Inspite of its eclipses in the past the town is rapidly growing in importance now. It was only in the last decade that the town turned into a city by adding 48,545 persons to its population and exhibited a marked mean decennial growth rate of 46.0. Indore is undoubtedly the greatest town of this division. It is the first largest city of Madhya Predesh with a population of 310,859. Situated at the intersection of the commercial hinterland of no less than four districts, this is the most progressive city. It is a big centre of textile industry, trade and education. It has a glorious history. In 1801 it served as the capital of Malharro II, and since then it has continued as an important capital centre of Madhya Bharat. It has a Municipal Corporation since 1868. Since 1921 it has shown a continuously high mean decennial growth rate, and has added more than two lakhs of people to its population. Its urban population has grown by 81.5% since

1931, where as the rural population has gained an increase of only 20.0%. Other important towns of this division are class III or IV towns. A prosperous town is Shajapur which has shown an urban increase of 62.4% in the last two decades. Bhilsa has registered a decrease of 0.7% and 3.2% in its total and rural population respectively, but it has grown in its urban population by 31.5% during the last decade 1941-51.

The M. B. Plateau Division has recorded within the last 30 years an increase of 109.8% in its urban population, while its rural population has grown by only 28.6%. This high figure of urban increase has been largely due to the growth of Indore by 52.6% and of Ujjain by 60% between 1941-51. Ratlam has shown an increase of 41% and the class III towns of 30.2%. However, small towns in class IV and V have registered diminished increases. This shows that urbanisation has proceeded in two dimensions : (i) a higher proportion of total population living in urban areas and (ii) in the urban areas localities with over 20,000 persons growing at a greater rate than others. This picture will become very clear by looking at the following table showing growth in towns of Madhya Bharat over three decades :—

| Class of towns | Nos. | Proportion to total urban pop. | Percentage increase in 1941-51 | 1931-41 | 1921-31 |
|---|---|---|---|---|---|
| (1) | (2) | (3) | (4) | (5) | (6) |
| I | 3 | 47.3 | 45.9 | 42.2 | 23.8 |
| II | 1 | 4.4 | 41.1 | 19.3 | 25.0 |
| III | 8 | 15.6 | 30.2 | 23.4 | 11.7 |
| IV | 12 | 11.7 | 28.6 | 29.4 | 11.3 |
| V | 43 | 21.0 | 16.8 | 17.9 | 8.2 |
| VI | nil | nil | nil | nil | nil |

Thus, over the thirty-year period since 1921 Class I towns have shown an increase of 157% ; Class II 110% ; Class III 80% ; Class IV 89% and Class V only 49%. It is also evident that the greatest degree of growth has taken place in the population of cities whose total population in 1951 was 682,253 which was more than double of 1921. The table also indicates a very strong trend towards concentration of the urban population in large cities and towns under the influence of commercial and industrial development. Introduction of motor-bus services between villages and towns has considerably helped in this growth. Thus, today there are thousands of

labourers who find it possible to live in urban areas and yet keep alive their connection with the village and even with its soil by paying frequent visits to their homes.1

(B) (iii) *M. B. Hills Division*—This comprises the districts of Dhar, Jhabua and Nimar. The following table shows the percentage variation of population in this division :—

| District | 1931-41 | | | 1941-51 | | |
|---|---|---|---|---|---|---|
| | Total | Rural | Urban | Total | Rural | Urban |
| 1. Dhar | 9·5 | 9·2 | 13·3 | 6·4 | 6·4 | 6·0 |
| 2. Jhabua | 17·4 | 17·4 | 18·8 | 11·5 | 11·2 | 26·5 |
| 3. Nimar (Khargon) | 15·0 | 14·1 | 23·5 | 11·4 | 10·0 | 22·7 |
| M. B. Hills | 13·8 | 13·2 | 19·7 | 9·8 | 9·2 | 17·4 |

This Division has not shown any marked urbanisation as the region is hilly and backward with very insignificant facilities for transportation. It is populated by Bhils and other backward tribes who are not attracted by the town life. The whole Division has recorded within the last thirty years an increase only 51·2% in its urban population, as against 43·1% in the rural. The area lacks in natural resources generally and has no important towns. Only Dhar and Khargon are Class III towns of small population.

(C) (iv) *Vindhya Pradesh Division*—Eight districts of Sidhi, Rewa, Satna, Shahdol, Datia, Chhatarpur, Tikamgarh and Panna come in this Division. In 1951 Census 64 towns were recorded in Vindhya Pradesh as against 19 in 1941. This growth was generally due to internal migration from the rural areas and to migration from the neighbouring States to towns in V. P. The following table shows the percentage variation of population in this division :—

| District | 1931-41 | | | 1941-51 | | |
|---|---|---|---|---|---|---|
| | Total | Rural | Urban | Total | Rural | Urban |
| 1. Sidhi | 17·21 | 17·21 | — | 9·46 | 9·46 | — |
| 2. Rewa | 14·44 | 14·81 | 11·03 | 8·06 | 7·81 | 10·54 |
| 3. Satna | 15·41 | 15·52 | 14·39 | 4·72 | 2·47 | 27·18 |
| 4. Shahdol | 14·23 | 13·98 | 17·44 | 9·41 | 8·34 | 22·64 |
| 5. Datia | 10·80 | 9·40 | 16·94 | 0·60 | 3·63 | 17·98 |
| 6. Chhatarpur | 6·92 | 6·39 | 12·18 | 3·68 | 2·96 | 10·52 |
| 7. Tikamgarh | 11·96 | 11·95 | 12·15 | 3·15 | 3·86 | -7·67 |
| 8. Panna | 15·85 | 15·77 | 16·56 | 4·18 | 5·37 | -7·06 |

1. Ibid. P. 31.

It is quite obvious from this table that only Satna and Shahdol increased their urban population to any significant degree, the variation being 41·57% and 40·08% respectively during the 20 years from 1931 to 1951. Satna recorded a mean decennial growth of 23·93 and Shahdol of 20·34 during 1941-51 because these two districts possess 4/5th of the total rail mileage of V. P. Towns have grown in them due to increased export-import trade. Lime and limestone in Satna district and forest produce in both of them are collected and exported. On the contrary, urban population in Tikamgarh and Panna districts decreased during the same period as the old Capital towns of the States showed a decline.

If we compare the percentage variation in rural and urban population we find that population in urban areas has increased at a greater pace than the population in the rural areas. The development of roads and facilities of communication, increase of production and consequential increases in export-import trade, all have led to an increase in the urban population of the division. The urban population in V. P. in 1951 was 8·56% of the total population, having increased by 13·36% from 1941 and 29·34% from 1931. Besides the causes listed above such other factors as organisation of transport service, establishment of flour and oil mills, increase of educational institutions, starting of small and subsidiary industries etc. have also contributed to the growth of urban population in towns. Some villages e. g. Sidhi and Majhauli, are growing into towns.

As between the two parts of V. P. —Bundelkhand and Baghelkhand— the former had in 1951 about 10·17% of its population living in towns of over 5000, while the latter had only 7·67% and nearly half of its total urban population lived in towns below 5000.

During the period 1901-51 the urban population of V. P. has increased by only 43·93%, and the greatest increase was of 13·36%, recorded in the last decade of 1941-51. Thus it is clear that as compared to Madhya Bharat Division this division has not progressed significantly in urbanisation. There is no city and though the number of towns is 64, most of them have populations of 20,000 or less.

(C) (v) *Bhopal Division*—It is a very small division of two districts—Sehore and Raisen. The following table gives the the percentage variation of population in it :—

| | 1931-41 | | | 1941-51 | | |
|---|---|---|---|---|---|---|
| District | Total | Rural | Urban | Total | Rural | Urban |
| 1. Sehore | 9·5 | 6·5 | 22·4 | 11·3 | 5·7 | 32·5 |
| 2. Raisen | 4·7 | 4·6 | 16·9 | 1·6 | 0·9 | 51·0 |

This division has the Capital city of Bhopal and three more towns of Sehore, Astha and Begumganj. Bhopal is developing fast into an important centre on account of it being the seat of M. P. Govt. It showed an increase in population of 36% in 1941-51. Sehore is a Class III town, and Astha and Begumganj are Class V towns.

(C) (vi) **N. W. Madhya Pradesh Division**—This division contains the 10 districts of Mandla, Sagar, Damoh, Jabalpur, Hoshangabad, Nimar, Seoni, Narsinghpur, Betul and Chhindwara. In the 1951 Census Damoh, Seoni and Narsinghpur were not returned as separate districts. The following table gives the percentage variation of population in this division :—

| | 1931-41 | | | 1941-51 | | |
|---|---|---|---|---|---|---|
| District | Total | Rural | Urban | Total | Rural | Urban |
| 1. Mandla | 13·19 | 12·47 | 52·67 | 8·53 | 8·33 | 16·66 |
| 2. Sagar | 10·43 | 9·85 | 14·39 | 5·68 | 1·14 | 35 81 |
| 3. Jabalpur | 17·68 | 12·69 | 38·05 | 14·99 | 6 79 | 42·29 |
| 4. Hoshangabad | 1·74 | -0·38 | 19·33 | 1·18 | -2·38 | 25·88 |
| 5. Nimar | 9·91 | 8·31 | 17·53 | 5·27 | -0·82 | 31·93 |
| 6. Betul | 7·90 | 6·30 | 49·53 | 3·04 | 0·48 | 50·57 |
| 7. Chhindwara | 6·93 | 6·09 | 22·17 | 4·49 | 1·58 | 18·75 |

The mean decennial growth rate of the urban population in this division has been the largest. In 1921-30 it was as low as 17·7 but it rose to 21·7 in 1931-40 and to 25·9 in 1941-50. We also see from the above table that excepting Mandla and Chhindwara all other districts have shown marked urbanisation. During the last 50 years almost all the towns have shown fair increase in population. In Nimar ( Khandwa ) and Hoshangabad the rural population, in fact, decreased during 1941-51 by 0·82 and 2·38% respectively, but the urban population registered an increase of 31·93 and 25·881 respectively.

The main cause of this rapid increase in the urban population is the rapid growth of towns in the Sagar, Jabalpur, Betul and Nimar districts. The development of the city of Jabalpur

is due to the industrial activities. Khamaria, which was a deserted village in 1941, is now a part of the city of Jabalpur. This township has grown up as a result of the War II and the Khamaria Ordnance Factories. Jabalpur is the second largest city of the State of M. P. with a population of 256,998 in 1951. Within the period 1901-51 its population increased by 183·9%, the largest increase occurring since 1931. During the two decades ending 1951 the city has shown a rapid urbanisation, and the district as a whole has increasecd its urban population by 80·34%. Jabalpur is a big railway centre, an important military centre, and has a variety of small scale and cottage industries. Beside the big factories of the Gun Carriage and the Khamaria Ordnance, it has two potteries, an engineering and foundry works, a glass works, saw-mills, flour-mills, handloom weaving centres, wood-carving, stonecutting, brasswares, bamboo works, furniture making, toys, bidi and miscellaneous manufactures. It has quite efficient transport facilities and is linked by motor-bus to almost all the important cities and centres of Madhya Pradesh.

Next to Jabalpur comes the town of Burhanpur with 70,066 persons. Actually this town has been gradually expanding and has a flourishing textile industry, grain and cotton trade. A newsprint mill has grown up at Chandni ( Nepanagar ). Then comes Sagar with 66,442 people. This town has recorded a growth of 111·5% during 1901-51, and an increase of 50·20% in its urban population during 1931-51. Damoh which was formerly a tahsil headquarters has grown up into a district headquarters with an increase of 67·22% in its urban population during 1931-51. Similarly, Narsinghpur and Seoni have become district headquarters with increase of 57·86% and 49·56% respectively in their urban population during 1931-51.

The bigger towns of this Division have shown quite large increases indicating that the very fact of their being large has contributed to a certain extent to their large percentage increases. Some of the smallar towns have also shown remarkable development. The case of Multai in Betul district is perhaps the most remarkable as it has increased its population from 3,339 to 11,768 persons. Development of road and rail transport in this tahsil headquarter town has helped considerably in its growth. The town of Betul itself has risen from 5,566 persons in 1901 to 15,563 in 1951. This is mainly due to industries and commerce because

we find that about 40% of the population of the town belong to industrial and commercial classes and about 44% to services etc. Similar is the case of Katni-Murwara, a town situated about 53 miles away from Jabalpur on the Jabalpur-Allahabad section of the Central Railway. The population of this town was 14137 in 1901, but it increased to 33884 in 1951, marking a net variation of 19747 during the fifty-year period. This rapid increase is essentially the result of the working of the cement and lime factories, and of its being a town on the cross-roads and a railway junction.

The following table gives the distribution of towns in this Division :

| Division | | | No. of towns |
|---|---|---|---|
| **1. N. W. Madhya Pradesh** | — | — | 37 |
| (a) Narmada Valley | — | — | 29 |
| (i) Sagar district | — | 9 | |
| (ii) Jabalpur ,, | — | 5 | |
| (iii) Hoshangabad | — | 13 | |
| (iv) Nimar | — | 2 | |
| (b) Plateau | — | — | 8 |
| (i) Mandla distt. | — | 1 | |
| (ii) Betul ,, | — | 3 | |
| (iii) Chhindwara | — | 4 | |

It is evident from the above table that the rich Narmada Valley possesses 78% of the total number of towns of this Division. The Plateau is poor and it is unlikely that it will ever become densely urbanised. The only big town of this region is Chhindwara where coal mining industry is of considerable importance.

(D)(vii) **East Madhya Pradesh Division**—This division contains the districts of Balaghat, Raipur, Bilaspur, Durg, Bastar, Raigarh and Surguja belonging to the new M. P. The following table gives the percentage variation of population in this division :

| District | 1931—41 | | | 1941—51 | | |
|---|---|---|---|---|---|---|
| | Total | Rural | Urban | Total | Rural | Urban |
| 1. Balaghat | 12.26 | 11.64 | 88.33 | 9.31 | 6.04 | 99.04 |
| 2. Raipur | 10.98 | 9.82 | 32.04 | 8.13 | 6.44 | 33.65 |
| 3. Bilaspur | 12.57 | 12.09 | 26.28 | 8.39 | 8.31 | 10.65 |
| 4. Durg | 12.15 | 11.53 | 28.19 | 4.67 | 3.53 | 30.39 |
| 5. Bastar | 18.54 | 18.82 | 6.76 | 16.15 | 16.71 | 13.59 |
| 6. Raigarh | 13.86 | 12.82 | 39.77 | 8.19 | 6.26 | 51.58 |
| 7. Surguja | 13.59 | 8.93 | — — | 17.45 | 19.31 | -25.99 |

The Division has no Class I towns or cities. Raipur and Bilaspur are Class II and III towns respectively. The commercial importance of Raipur and its trade in grains are well known. Balaghat has shown remarkable urbanisation since 1931 the percentage increase being 178.34. This is due to the mining and forest industries in the district, which have improved considerably in the recent past. Balaghat is the headquarters of the district and has great commerical and administrative importance. Then, there is Raigarh which has increased its population from 6765 to 29184 within the period 1901—51. It has grown rapidly due to its benig an important railway centre providing an outlet to the large backward areas of the old Surguja, Sarangarh and Raigarh states. Rajnandgaon and Durg are other small towns of some importance. They are developing due to the development of the of the electric grid system and the supply of cheap power from Raipur. Recently, the establishment of a big Steel Plant at Bhilai, only 1 or 7 miles from Durg, has helped much in urbanisa- of this area.

The following table shows the distribution of towns in this Division :

| Division | | | No. of towns |
|---|---|---|---|
| **East Madhya Pradesh** | — | | 30 |
| (a) Chhattisgarh | — | | 27 |
| (i) Raipur distt. | — | 4 | |
| (ii) Bilaspur ,, | — | 4 | |
| (iii) Durg ,, | — | 7 | |
| (iv) Bastar ,, | — | 2 | |
| (v) Raigarh ,, | — | 1 | |
| (vi) Surguja ,, | — | 4 | |
| (b) (vii) Balaghat ,, | — | | 3 |

It is evident that the Chhattisgarh region has greatest number of towns the due to its agricultural, commercial and industrial facilities. It has been famous for its production of rice since early times and now it is becoming famous for its mineral and steel industries.

**Summary and Conclusion :** In new Madhya Pradesh the areas of greater urbanisation in 1951 were the major portions of Madhya Bharat Plateau Division, Madhya Bharat Lowland Division (Gird), the Narmada Valley and the Chhattisgarh plain.

The hilly and forested parts e.g. M.B. Hills Division, Baghelkhand, Vindhyan and Satpura hill tracts had a few and smaller urban centres. Though the State has shown a marked trend towards urbanisation, it is still backward in comparision to some other States of the country, It has only five cities in a total area of 171,052 sq. miles. Since 1901 there has been an addition of only about 2 million in the urban population as against 10 million in the total population. Again, most of the urban centres are small Class IV or V towns scattered here and there. Changes in the economic and political set-up of the State have been responsible for a greater trend towards urbanisation than in the past. As for example Bhopal and Ujjain attained the status of a city only in 1941-51 decade. The former has been made the State Capital and because of this political factor it is fast developing into a very big industrial and commercial centre. Similarly, Durg and Bhilai have assumed great importance due to setting up the Steel Plant at Bhilai. Mining and industrial expansion have pushed up many small towns into importance e. g. Maihar, Katni, Balaghat, Chhindwara etc. Many parts of the State are densely forested and inhabited by backward tribes and suffer from lack of transport facilites. These are not likely to get urbanised until the areas are opened up by good means of transport and facilities of education, health and sanitation. The biggest district of the State, Bastar, is a glaring example in this respect.

# SOME PRELIMINARY OBSERVATIONS ON THE GEOMORPHOLOGY OF THE LOWER LUNI BASIN

B. Ghose & A. K. Sen

The Lower Luni basin is confined between 25°30' N to 25°50' N and 72°0 E to 73°0' E. It comprises a portion of Balotra sub-division of the Barmer district and Jalore sub-division of the Jalore district. The total area is about 800 square miles.

The Total length of the Luni is near about 500 miles, its average slope is 1 in 500, depth 8 feet, width 3,800 feet and and approximate basin area 24,116 square miles. Total water potential of the Luni has been estimated as 0·85 m. a. feet, and available surface water potential 0·42 m. a. feet. Available ground water potential is 10·43 m. a. feet of which utilizable surface potential is 0·23 m. a. feet and utilisable ground water potential 10·20 m. a. feet (Dhir and Krishnamurthy 1952)

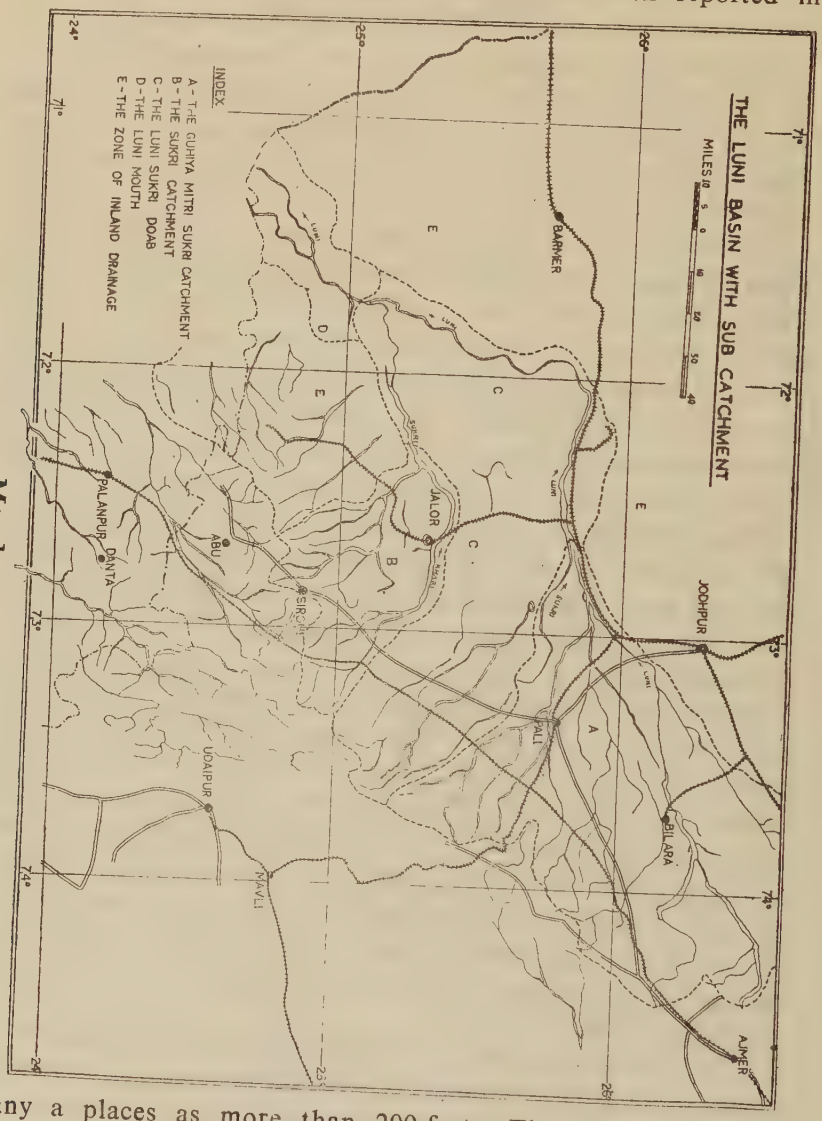
The Luni rises in the Aravallis, south West of Ajmer city. The local meaning of the word 'Luni' is salty and it has been reported that the ground water at most places is saline or brackish in the Luni basin. The ground water is also getting more saline.

On the basis of drainage systems four geomorphic units may be identified in the Luni basin. (a) Mitri, Guhiya, Bundi and Sukri catchment or the upper Luni catchment. (b) Sukar catchment—the system that joins the Luni long after its great bend at Tilwara, only a few miles upstream, where the Luni is lost in the Rann of Cutch. (c) The Luni-Sukar doab where the evidences of inland drainage and aridity are more common ( Lower Luni ) (d) The Luni mouth—below its confluence with the Sukar to the Rann of Cutch. The study has been made in the upper part of 'C' unit.

The entire tract receives an annual rainfall of about 10 to 15 inches. Towards the east the rainfall is comparatively higher than the west. In such an arin type of climate 'steppe' desert conditions prevail. About one third of the area is rocky with some pre-cambrian and other rocks as foundations. Xerophytic grasses, common in steppe deserts, exist almost throughout the tract.

The greater part of the region is covered by alluvium and wind blown sands. Alluviums are found in an area of about half a miles in width, confined in a long narrow strip, parallel

to the Luni where it runs in an E.-W. direction. Actually this forms the flood plain of the Luni. Other areas are covered by wind blown sand, the thickness of which has been reported in




Map 1

many a places as more than 200 feet. The alluvium deposits along the small streams are mostly covered by wind blown sand. The sand extends in a lesser degree towards the east. Older geological formations are marked in the hilly and mountainous areas of Jasol, Samdari, Siwana in the west and Rama Bhadrajan in the east. The underlying rock formations are Rhyolites, typical reddish coloured rocks with por-phyritic feldspars. In Samdari, Siwana and Jasol area the rhyolites

crop out as isolated hillocks, the intervening flat regions being covered with sand and occasional kankar layers. In the flat regions the sands on the surface are mostly loose and are played on by winds to form dunes. The rhyolites are traversed by fairly well defined joints. The main system of joints exposed near Samdari are N. E.—S. W. and N. W.—S. E. Both the sets dip at a steep angle. Towards the south of Siwana granites traverse the rhyolites. The granites are not ore bearing ones. The rhyolites are volcanic representative.

The Luni is essentially an ephemeral stream. There is no integrated net work of streams owing to low rainfall, high evaporation and extensive tracts of sand dunes which impede surface drainage. The river marks the northern boundary of the region and has an E.-W. course till Tilwara and Gol in the West. At Gol the river turns southwards taking an unusual bend and runs straight towards the south. No signs of geomorphic interest, however, are associated with the bend and the reason seems to be the adjustment of drainage to the structure. The profile of the river is mature. The river bed is sufficiently wide due to lateral corrasion. The river, meandering through a dissected plateau, gives the impression that it has attained more than one base level of erosion But throughout the course no sign of stream rejuvenation has been marked. It is probably due to the fact that the original landscape has been burried under thick wind blown deposits.

The streams and gullys coming out of the hills along with other rivers of the tract have got lost in the wind blown sands that cover the landscape, or in the detritus brought from the enclosing ridges.

An interesting feature of the drainage in the Siwana area is the inland basin enclosed between parallel ridges. To the south of Siwana is a ridge running from Mokrasal to Dharna and parallel to it there is a ridge in the south. The drainage in between the ridges is towards the west. Valley floors in both the cases are wide. The homoclinal ridges and valleys give a resemblance of a trellised type of drainage.

Both the rivers are ephemeral and are lost in the sandy deposits and are hence true arid or semi-arid streams.

The adjustment of the drainage to the structure can hardly be observed due to original topography being mostly filled up by porous alluvium or inblown sands.

A sudden plunge of the fold axis may have caused the sudden termination of the ridges in places. The hill to the east in Rama-Bhadrajan area, is a typical "boss" with a canoe like shape. Further, north the same hill plunges deeply under alluvium near Bankli, and terminates. The adjecnt Sukri valley seems to be an anticlinal valley.

In the Siwana area the folds are of much larger dimensions. Here homoclinal hogback ridges are common. The quick change from rhyolite to granite and back to rhyolite is expressed in sudden termination of the rhyolite strike ridges and resumption in the same trend after a gap. Some isolated hills in the Siwana and Heli areas resemble inselbergs, but origin of low relief cannot be attributed to wind only. The polishing of rocks by wind blown sand and wind erosion is very common.

The action of wind erosion and deflation can also be marked in the hills of Siwana and Jasol. The mushroom forms of the rock masses are due to the undercutting action of wind. Near Thapan, on Balotra-Siwana road, dunes are formed on structural terraces. Continued wind erosion has eroded the softer materials in the Siwana hills and in many cases, particularly to the north of Meli, in Siwana area, the ridges have assumed the characteristic forms of 'Zugen'. In Kundal area, the hollows or caves of the hills seemed to have been formed by intermittent attack of wind driven sand. Localised action of wind has produced flutting and channelling in the hills of Siwana and Jasol. The highly weathered and disintegrated rocks also reveal the characteristics of a long period of mechanical weathering and aridity. Some potholes along the hills may be due to humid erosion in the past which demand further investigation.

The area is extensively covered by plains of various characters. There is a prominent break or change in slope right at the foot of the hills. In general hill slopes of the area range between 20° -40°. Below the break the slcpe is 8°-3° which gradually become flatter. The somewhat steep upper portion is a rock cut plain or pediment. The average width of these plains of degradation is a mile. In some cases these plains plunge below alluvium. This is the *bajada* or plain of agradation which covers quite an extensive area in the region under consideration. The narrow strip along the Luni is a typical flood plain with clay deposits as a conspicuous feature. It has its futher extension in between Siwana and Rama Bhadrajan hills. The region here is coverd by

thick wind borne deposits. Over this plain there are a number of shallow closed depressions or lakes, locally known as 'rann.' Local run-off is lost by evaporation or by infiltration in the ground. Sanwarla ka rann, Nilkhant, Bandla, and Bola are four such depressions here. Salty deposits are common in Sanwarla ka. rann. Over it fluviatile deposits are also found. At the margin several dried up stream heads can also be traced. It may be a central lake or playa on arid landscaps which once formed the outlets of consequent drainage lines. It may also be a detached portion of Jurasic sea that once prevailed throughout the tract. A feature noted on the Sanwarla ka rann, is a silted up deposit more akin to a central lake or playa. Wind blown deposits over the plains have already been discussed. Dunes are the most prominent feature of landscape in the west and south west. The dunes here are mostly stabilised due to encroaching vegetation. The dunes are localised in the places where the wind blown sands are held by the hills and as such they are overlain on a buried ridge or an earlier peneplane surface. The shape of the dunes is mostly irregular in the Paderu and Siwana area. The shape seems to have been controlled by the shape of the under ground ridges. In general they are mostly transverse in type. The profile is mostly 'u' shaped. In the west, in Dhakan, Unchi ka Dhani, Simalia, Tilwara etc., the dunes are both longitudinal and transverse and lie along the prevailing ( S. W. monsoon ) wind, in a S. W.-N. E. direction ( Roaghly transverse to the direction of the Luni ).

Considering the regional distribution of the dunes, the Luni flood plain is primarily a dune free region. The western scarp of Rama-Bhadrajan hilly areas is silghtly dune-fed where only 0 to 10% of the total area is affected.

The Western and south western region is practically a dune fed plateau where the whole of the region is a severly dune fed area. But the total land affected seems to be controlled by some topographic features which appear to be burried and require futher investigations. In the Siwana area the dunes are found only along the windward side of the hills where upto 25% of the lands are affected.

As many hills and ridges of the area rise to heights varying between 2000′ in the east and 3000′ in the west, their tops may be thought to represent eroded remnants of an ancient peneplane. A lower erosinal surface at, about 1000′—1500′ in the Siwana—

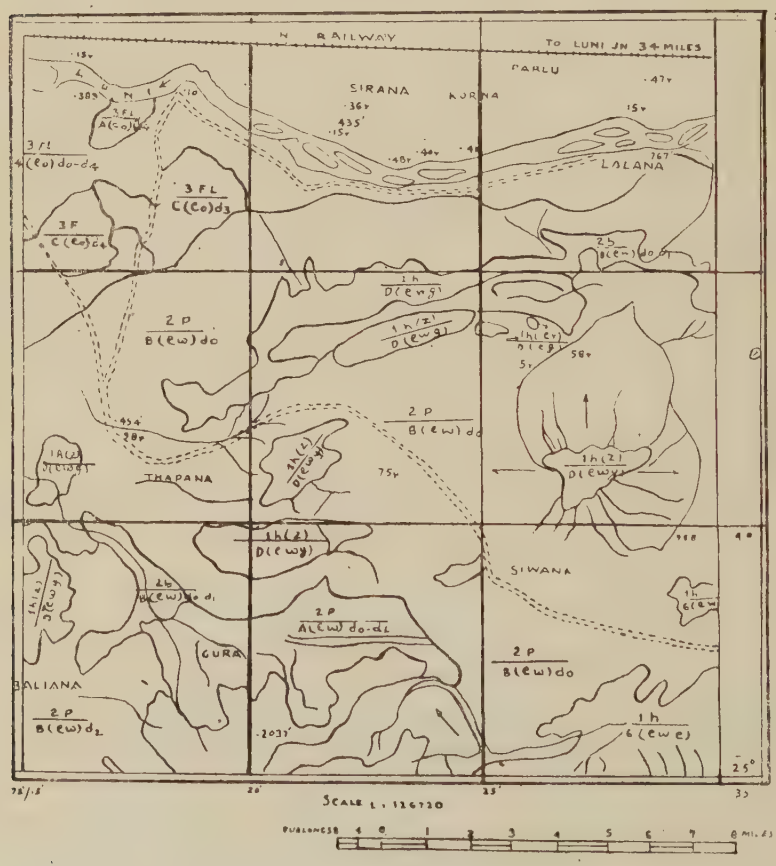
Makrasal area is evident. The surface seems to be well advanced towards peneplanation. The dunes seem to have accumulated on the peneplane of a lower erosinal surface at 500′—600′. But the original surface can not be ascertained due to the thick accumulation of sands. The surface in seen is Siwana enclosed basin region. This may be due to a recent uplift.

Thus there are evidences of at least three erosional surfaces.

## Land scape pattern

The landscape pattern as described above may be briefly mentioned as under :

(1) The hills of Rama-Bhadrajan in the east, Samdari, Jasol and Siwana in the west represent stable land surfaces composed of older pre-cambrian rocks. On the windward side of the hills the blown sands are dashed against the hills polishing and eroding the rocks.




LAND PATTERN IN SIWANA AREA
LOWER LUNI BASIN

Map 2

(2) A zone of plain of degradation parallel to the hills, i.e. rock cut plain or peidmont

(3) Further down the peidmont, parallel to the hills is a zone of plain of agradation or Bajada.

(4) Along a narrow strip, parallel to the Luni is a zone of alluviation or flood plain.

(5) Enclosed by the mountains in ths east and west and to the south of the Luni flood plain is a vast area of flat to undulating plain covered up by alluvium and wind blown sands. The essential flatness of the relief is broken by *rann* depressions. The landscape assumes the aspect of a 'steppe' desert.

(6) A dune fed plateau in the west and south-west is surrounded by the Luni on the north-east, mountains of Jasol in the north and Siwana on the west. The plateau seems to represent an area of a burried hills landscape.

(7) The Siwana country represents intermont basin landscape. Over much of the area, fracture gave an initial topography of titled fault blocks separated by intermontane plains.

Throughout the area examined, accumulation of blown sand is universal. Away from the Luni the drainage lines are ill defined.

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## Legends of Map 2

The thick continuous black lines indicate the boundaries of LAND TYPE UNITS. The code for LAND TYPE UNITS in the map have been arranged in the form of a fraction with land type, topographic forms in the numerator and degree of slopes, nature and type of erosion within bracket and degree of sand dunes in the denominator. The land type has been shown by numbers like 1, 2, 3, etc. Each land type has been divided into units on the basis of topographic forms, slope, erosion and dunes represented by abbreviations as follows :

### Topographice Forms

h— Hill
fl— Flood plain
FL— Flat land
FU— Flat to undulating
P— Peidmont
b— Bajada
z— Zugen
h (er)—Erosional hill

### Land Type

1. Stable land surface
2. Erosinal land surface
3. Depositional land surface

### Degree of Slope

A— Level to nearly level 0% to 1%
B— Gently sloping 1% to 3%
C— Moderately sloping 3% to 5%
D— Moderate to strongly sloping 8% to 15%
E— Strongly sloping to steep 15% to 25%
F— Steep to very steep 25% to 40%
G— Very steep 40% and above

### Erosion

( Represented in bracket in the denominator of the code. )

ew— Wind erosion
eg— gully erosion
es— Sheet erosion
er— Rill erosion
ewg etc.— Wind and gully erosion etc.

### Dunes

d0— No dunes
d1— Slightly dune fed area
d2— Moderately dune fed area
d3— Moderate to severely dune fed area
d4— Severely dune fed area
d5— Very severely dune fed area

75′r′ indicates water table 75′ below the surface.
.360′ indicates Bench mark.

# MORPHO-ECOLOGY IN AND AROUND PIR PANJAL

S. C. Bose

Geomorphology in the Himalayas plays a very important part in moulding human activities. It is more so in steep and rugged landscapes, where river terraces, alluvium filled basins and the degree of slope together with altitude determine land use. They control the pattern of routes and the flow and intermixture of culture. The term "morpho-ecology" has been coined to denote this relotionship between landforms and man's adaptation to it. A study of this relationship in and around Pir Panjal is of special interest to Human Geographers.

Among the smaller ranges running parallel to the main Himalaya Range, south of it, in the Western Himalayas, Pir Panjal and Dhaola Dhar are the most conspicuous. Their crests are more or less covered by perpetual snow, and are seen stretching from east to west as a dazzling array of silvery peaks from the plains of Panjab. D. N. Wadia rightly refers to Pir Panjal as the most dominant feature in the geography of the region.[1] The view of thus mighty range from Patni pass (2027 metres) between Kud and Batoti, across Dhaola Dhar, on the road to Kashmir from Jammu, reveals its magnitude. Another grand view of Pir Panjal is obtain from Koti Rest House[6] in Kulu.

The range is about 400 kilometres long stretching from Jamgarh peak (4733 m) west of Kishenganga, through Kashmir, Chamba and Kulu to Deo Tibba (6221 m), where it merges with the Great Himalaya range, to which alone it is second (in length as well as altitude) in the country.

According to Burrard and Hayden[2], however, it continues more or less obscurely as a geographic feature as far as Sutlej, where it fuses with the northern flank of Dhaola Dhar. But this statement is not quite correct and Deo Tibba is clearly its eastern extremity.

The range is cut through by deep gorges at two places ; by the Jhelum below Baramula and by Chenab below Kishtwar. The height of the range increases towards the east, the highest peak being Deo Tibba in the eastern extremity. In Lahul there are four peaks above 6000 metres. The Kishtwar gorge is in the middle of the range. The altitude of the river bed here is about 1000 metres, while the range rises over 3000 metres on both

sides of it to Naginsheru (4089 m) in the east and Piparan (4041 m) in the west.

In Lahul passes are very high and difficult. The lowest pass is Rohtang (3979 m), which is closed to traffic in winther, when blizzards rage through it.

In the western half of the range there are no peaks above 5000 metres. The highest peak is Tatakuti (4742 m) and the next is Brahma Sakli (4705 m). The most easily accessible peak is Apharwat (4143 m), just above Gulmarg. The lowest pass in the range, Banihal (2832 m) is situated west of Brahma Salkli. The old Jammu-Srinagar road passed across it, though at present it crosses the range at a lower level (2300 m) through the two kilometre long, double Jawahar Tunnel. The old road over the pass was snow-bound during winter, but the Jawahar Tunnel can be kept open all the year round, with some trouble, and this is the only motor road in India across Pir Panjal. (Plate I, bottom right photograph).

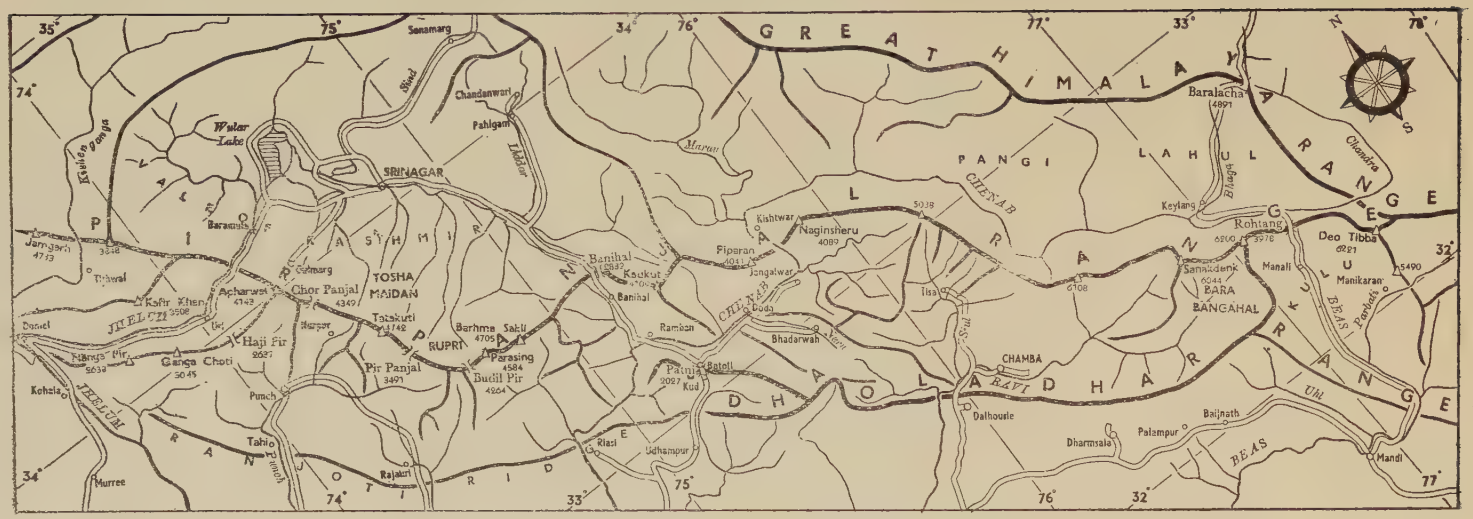
Another very good motor road comes from Rawalpindi and Murree in Pakistan. It crosscs the Jhelum at Kohala and then follows the river to Srinagar. The old Mughal road is now only a mule track. It starts from Punch and crosses over by the Chor Panjal pass (3491 m). In Mughal times, horse driven carts followed this route.

The short physical description of the range given above shows that this great range is an economic, cultural and even climate divide between its two faces. The people living south of the crest have ties with the plains of Punjab, but the people living on the northern side have quite different customs and manners.

Structurally Pir Panjal range "is a highly individualized unit, as conspicuous by reason of its great topographic distinction as by its marked difference of geological constitution."[1] In fact the trend of the range at its western extremity is better understood by a study of its structure.

Before the monumental work of D. N. Wadia on Western Pir Panjal, Lydekker[3] and Medlicott[4] recognised the uniqueness of Pir Panjal structure, but presented a very much generalised picture of it. They considered the south-western half of Pir Panjal as composed of one monotonous, undifferentiated, metamorphic series of slates and traps (the Panjal system), with a narrow strip of unfossiliferous sediments of Carbo-Trias age (the Kuling and Supra-Kuling series) along its border. A thick core of gneissose

# PIR PANJAL RANGE



granite was depicted as forming the central axis of peaks along its whole length, from the Banihal pass to the Jhelum gorge below Baramula. However, D. N. Wadia completely changed these views. According to him Lydekkers' Panjal slates and traps belong to three distinct rock systems of as many different ages.[1] These are (a) Dogra Slates composed of metamorphosed phyllitic, black clay slates and schists and phyllites with abundant interbedded chloritised trap, pointing to contemporaneous volcanic action. (b) A series of intensely black, sooty, agglomeratic slates and tuffs of upper carboniferous (Talchir) age, some thousands of feet thick, whose volcanic explosive origin in made apparent by frequent inclusion of crystals of felspars, angular pieces of quartz, and presence of glassy isotropic base. (c) A group of partly metamorphosed sandy shales, clays and sandstones overlying the Agglomeratic Slates, which indicate a shallow water fluviatile origin from the colour-banding, rapid alteration of coarse and fine grain, and a few obscure marks of fossil leaves. This has been referred to as Gondwana system.

The volcanic trap-flows of the Panjal system belong to two distinct types of widely separated ages,[1] those associated with Dogra Slates consisting of erupted lava flows of basic composition now thorougly altered into chlorite schists,[2] and a much younger group of subaerially erupted lava flows of pyroxene-andesitic to basaltic composition, which cover an area of several thousand square kilometres in Kashmir,

Wadia also negatives Lydekkar's assumption of a granitic core of the range, and adds that the summit zone is composed, either of the Panjal trap flows, or the Agglomeratic slates and tuffs with small stretches of Gondwanas, This is also the view of Middlemiss.[5]

Wadia further describes the structure of Pir Panjal as "one of thrust-faulting and isoclinal folding. One violent overthrust is along the foot of the range, whilst the other separates the Eocene from the slate zone. The north-east dipping isoclines continue across the summit, through the opposite slopes, to the fringing Karewa beds on the south bank of Jhelum in Kashmir valley."[1]

A notable feature of the structure of Pir Panjal is an "extraordinary deflection inward of the strike of the ranges at Domel. Here together with the river, within a kilometre all the hill ranges have their orientation abruptly changed over an angle of 120° and the river is the pivot on which this great geniculate bend has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taken place."[1] The entire zone of the Outor and Middle Himalaya have shared in this flexure, described as the Jhelum syntaxis.

The presant Jhelum valley from its source near Vernag below Banihal tunnels to Domel is only a strike valley, the main stream being Kishenganga river which is fed by glaciers and icefields of Nanga Parbat (8114 m). The Jhelum has cut a deep gorge through the ranges above and below Domel.

Another feature of the Pir Panjal is its gabbro bosses which protrude through the central axial zone of the range between Tosha Maidan and Rupri near Tatakuti peak. The bosses are associated with a group of sills, mainly dolerite, penetrating along the bedding planes of Agglomeratic Slates into which the gabbro bosses intrude. "Two such sills, each over 100 feet in thickness, composed of a pale-green, coarse dolerite pursue a serpentine course for a few hundred yards through jet black Agglomeratic Slate precipices, which crown the slopes facing Poshiana just south of the Panjal pass. The striking colour difference of the invading sill and its winding outline among the inky blank country-rocks justifies the name of the hill Sarpi Sangur or hill of petrifi d snakes. A group of thick dolerite sills is observed in the high precipitous scarps at the foot of Tata Kuti. Bosses and sills of a similar nature are again observed north of Nurpur pass."[1]

Gneissic intrusives are not so frequent as gabbros. "The main intrusion of gneiss is typically exposed in the high Kopra hill mass (3191 m) about 8 miles south-west of Apharwat which shoots out prominantly from amidst the surrounding dark-grey softer slates with abrupt white granitic precipices rising nearly 300 metres. A series of remarkably continuous veins of quartz surround the main mass of the hill in all directions,"[1] and at places they become remarkable topographic features as near Danna, where the vein appears as a ten metres thick dyke crossing the deep defile of river Mandi, which drains the southern slopes of Pir Panjal south of Apharwat.

The Dogra slates produce gigantic cliffs in the Chang gorge south of Tatakuti and Betar valley north of Punch. These gorges are carved through slates, which at some spots appear to have better cleavages so as to produce material for roofing and building.

The central axis of Pir Panjal is almost wholly "built by agglomeratic slates and tuffs in conjunction with Panjal traps,

That part of the jagged and serrated crest, which extends between Nurpur and Rupri passes in a line of pinnacles and peaks including Tatakuti, is composed of tuffs and slates, permeated with dolerite sills."[1] North of Nurpur up to near Gulmarg the Panjal Traps form the crest.

The Gondwanas appear at Apharwat where they form the crest for some distance and stretch south of it, below the crest up to Pir Panjal pass. Towards the north they extend up to the Jhelum gorge. They are composed of moderately metamorphosed shales, argillaceous sandstone and quartzites. They overlie the Agglomeratic Slates comformably and the older Dogra Slates unconformably. They are generally marked by an extremely coarse boulder conglomerate at the base. Plate I, top photograph shows a panoramic view of the crest, the highest point being Apharwat peak. Frost action has shattered the slates to small bits scattered all over the area. The peak is more or less an accumulation of shattered rocks, which have slumped to a dome shape. On the southern side of the slope in a depression is a moraine plugged tarn named Alapathri (Plate II, bottom right). Shattered rock chips abound all round it, and snow beds cling to its sides throughout the year. The slope on the crest is quite gentle and pastures even at this height (over 4000 metres) along the crest are grazed by flocks of sheep till snow covers them in late October.

The cluster of elevated peaks around Tatakuti, formed of sooty black agglomeratic tuffs and slate have jagged splintered tops due to frost shattering. Stupendous, bare cliffs drop from one to two thousand metres south of the summit. Below the cliffs are large accumulations of morainic debris and boulder clay. The spurs here, around the Lungni Chasm south of Tatakuti are hog-backed and ice-planed, which support a number of high pasture grounds, such as Banota and Paspathri, where Gujars roam with their flocks. Their huts are built of solid deodar logs, the roof being protected by earth so as to stand the weight of snow. They are built in protected places among Deodar trees.

North of Tatakuti, west of the crest, the ground above Gujar sheds below Sultanpathri is littered with a tumultous assemblage of moraine blocks of trap, gabbro and dolerite covered by dense pine forests. Above Sultanpathri rise splintery trap crags, devoid of vegetation. A few snow beds cling to the valley floors. The crest here rises above 3,700 metres in rocky precipices, and the

topography is so rugged that even the ubiquitous Gujars have no resting place, and in their seasonal migrations keep away from this area.

Though there are no glaciers of appreciable size in the Pir Panjal today, it is quite clear from the topography that glacial denudation occured on both sides of the crest up to 2500 metres elevation, and the land forms obtained here are distinct from the subaerially sculptured ranges of lower elevation. Glacial features are also observed at Haji Pir and Ganga Choti. Here we not only meet huge and widely spread deposits of moraine, but also hummocky, moutonneed crests covered by grassy and flowery turf, amphitheatres in the sides of hills and and U-shaped valleys into which drop cascades of water from hanging valleys, such as in the Betar valley south of Haji Pir, and further west, the well known Nurichhan falls near Baramgala south of Pir Panjal pass.

"Of the valleys of Pir Panjal the Girjan valley running in a wide longitudinal basin along the strike, south of Pir Panjal pass is specially remarkable for its glacial features."[1] It has a perfect U-shape, with high valleys dropping in from both sides. At its head near Rupri on both sides of the crest there are numerous cirques and about 20 glacial lakes or tarns. The biggest of them is Bhag Sar nearly two kilometres long. The slopes in this area are covered by a series of extensive pastures and vivid green meadows.

The topography of the north-eastern slopes of Pir Panjal, gradually falling down to the level of the vale of Kashmir, is markedly different from that towards the south. The main features of the northern slopes is the masking of the solid geology by glacial debris and moraines. This has made the slopes gentle and reduced the ruggedness. There are broad slowly descending fields strewn with boulders. Pinus longifolia are absent and deodars appear below the tree line. Springs ooz out from the loose material all over the area. Grassy meadows and abundant spring water allows for an ideal habitat of Gujars and their flocks of sleep and cattle. There are hundreds of kilometres of rolling moraine covered slopes overgrown by meadows. These are the "Margs" of Kashmir. They are practically all over the area between the tree line and the snow line. Above 4000 metres tongues of corrie glaciers cling to the steeper slopes below the crest, descending down in winter and contracting and even dis-

appearing during summer, leaving their paths exposed, which look like rivers of boulders descending down the slopes. One meets such features on both sides of the crest. Two such bouldery paths are found on both sides of Apharwat.

Below the tree line patches of Margs appear between dense deodar forests, of which Gulmarg is famous for its velvety green meadow surrounded by tall dark green deodars, and backed by the snowy crest of Pir Panjal (Plate II, top right photograph). The meadow has an excellent golf course.

The origin of the present landscape is better understood by tertiary and recent geological movements. During the pleistocene, according to de Terra and Teilhard de Chardin[10], there were four distinct glacial phases and two or more uplifts of the Pir Panjal range, which gradually rose to its present huge diamensions. During the glacial phases its slopes were covered by huge glaciers. Morainic material carried by them was deposited at the bottom of a lake (Karewa lake) which filled the present valley of Kashmir.

During a later rise the Karewa beds were also lifted up along the flanks of Pir Panjal, but were subsequently covered by glacial debris.[7] The huge moraine deposits sometimes end in bluffs, below which appear the Karewa beds.

The slopes of Brahma Sakli and Parasing are covered by a large number of corrie glaciers, below which appear broad open meadows drained by Zajinar and its tributaries. The meadows spread north-westwards to Kharmarg, Buddh Angan, Tosha Maidan and lastly Khilanmarg above Gulmarg. Easy accessibility of Gulmarg has made it a tourists paradise. The motor road from Tanmarg has been extended to it, and a passenger rope trolly is being erected to connect it with Khilanmarg, whose gradually sloping meadow has provided an ideal place for winter sports. A ski club is located here.

Gujar huts are found from 3000 to 3500 metres, just below the tree line, in protected places amidst deodar trees. They consist of low shelters made up of solid logs of wood. There is no wall at the back and roofs join up with the up-sloping land. They are further strengthened by mud plaster. They can easily withstand heavy snow fall, and even small avalanches can go over them without doing any damage. Gujars live in them during summer and descend to the valley below during winter. In summer they bring milk, butter and cheese to the valley below,

specially at places where towns can be easily reached, such as at Gulmarg and Tanmarg, from where these are taken to Srinagar. Strangely Gujars speak a language akin to Panjabi, though they can speak Kashmiri as a second language. This has a bearing on their origin from Panjab. Their dress is also different from Kashmiris. Men wear "pagri" as head dress, instead of the conical cap of Kashmiris. They also adorn their faces with moustaches and beards. They are not as docile as the cultivating Kashmiris.

At the southeastern end of the Vale of Kashmir, at the foot of Pir Panjal are a number of large springs pouring out of underground tunnels in limestone. Such a spring is Vernag, which is so big that it gives birth to river Jhelum[7]. Jehangir the Mughal Emperor built a magnificent garden below it.

On the southern side of Pir Panjal the topography is much more rugged. The motor road to Srinagar descends steeply from Patni into the Chenab gorge, zigzaging down argillaceous rocks, which more than often obliterate the road by huge landslides, which have increased in number and volume as deforestation of pine forests (pinus longifolia) has continued unchecked.

Above Banihal town the upper reaches of Bichhlari river, a tributary of Chenab, spread out in a broad amphitheatre surrounded by craggy frost-shattered bare rocks along the main crest and its spurs. The basin is also divided into sections by sharp-edged spurs descending from the high ridges. An aerial view of this area is seen in plate I, lower left photograph. The location of Banihal town is due to cultivable slopes surrounding it. Rice fields on terraces, and maize on steeper slopes appear up to 2,800 metres. Pears, peaches and apples have been introduced from the valley of Kashmir, but they are of poor quality. Higher up on fans of talus are meadows, with their Gujars. Inbetween are forests of pine and deodar.

South of the main Pir Panjal range there are a number of parallel strike ridges. Of these Ranjoti ridge south of Punch made of limestone and dolomite, rising as an inlier from soft sandstones, is most prominent. This is the "Great limestone" of Medlicott, which attracted the notice of the Geological Survey because of its association with Eocene coal and was investigated by Medlicott in 1870 and later on by Wright[8]. The ridge forms "a very striking topographic feature, both from the abruptness of its relief and from the much worn serrated aspect of the steep

limestone and dolomite crags arising through soft Tertiary sandstones. It is crossed by a number of streams both transverse and lateral, which have cut out deep craggy canyon-shaped defiles, at places barely 20 metres in width, but with bare vertical precipices some hundreds of metres in height."[1] The limestone inlier appears again near Riasi and passes across river Chenab, producing a deep gorge. At Tahi south of Punch, a thermal sulphurous spring named Tatta Pani issues from limestones. The volume of water is large and it is clear and limpid with a temperature 80°C. Minor quantities of sulphur are deposited near the spring.

Springs also issue from gravelly alluvium covering rocks which supply water through fissures communicating with surrounding hills. Punch town stands on one such gravelly terrace, from which voluminous springs of fresh water pour out supplying all the water needed by the town.

While deodars grow on the high portions of the crest of Ranjoti ridge, pines are found lower down. Further down wild pomegranates grow in groves. Their sour seeds are used as condiment. Near Kud on the Jammu-Srinagar road, pomegranates grow profusely.

The most remarkable topographic feature in the central part of Pir Panjal is the great transverse gorge of Chenab below Kishtwar. This town is situated on a flat terrace 8 km by 3 km, about 300 metres above the gorge. It is an island of prosperity set in the middle of a scene of wild grandeur.

Terraces are also very prominent throughout this section of the river Chenab, which have led to the growth of a chain of big villages, such as Doda, Babhor, Jadhpur, Jatheli, Dirhot, Mandi and Barhut on the northern bank and Khateni, Thalela, Mangala, Diron, Hiran and Jangalwar on the south bank. A motor road passes over the southern terrace, and connects with India-Kashmir road at Batoti, going up to Jangalwar, and further as a track to Kishtwar. An important track also skirts the northern bank terrace. The terraces are two to three kilometres wide and end in steep scarp faces on both sides of the Chenab gorge.

River Neru joins the Chenab from the south at Doda. Terraces continue along it at the same level as those on the Chenab. But as the thalweg level of Neru is higher, the terraces are not flanked by scarp faces. The river water is easily obtained for various uses by the villagers living in the valley. A motor road bifurcates

from opposite Doda and goes to Bhadarwah over the terrace along the valley. Bhadarwah is situated in another bowl-like amphitheatre drained by the headwaters of Neru. With its terraced fields, gardens and forests surrounded by high ranges, its landscape is very attractive and its people are happy.

Features similar to Neru valley are met with in the Marau valley north of Kishtwar. The thalweg widens out here and there, where alluvium filled flat basins appear, resulting in prosperous villages. An example is the cul-de-sac of Lopor and Janatpor, adjoining and extending towards Sondar. Isolation is the keynote of the happy people living in it. They have, of necessity to be self sufficient, but they live "far from the madding crowd" of the modern civilization.

East of Naginsheru peak towering above the Kishtwar plain, Pir Panjal range attains a greater height and gradually rises to a number of peaks above 6000 metres. The range is covered by perpetual snow and corrie glaciers cling to its slopes, specially on the northern flanks, which is generally in shadow. In fact throughout the range, there is more snow on the north-eastern slopes, where it stays for a longer period after winter. It starts melting in April on the sun drenched southern slopes, but stays, on the northern slopes till the end of May. Small avalanches thunder down as the bases of snow patches get loose after melting, and are a source of danger, specially to traffic on the road near Banihal. Only goat tracks cross over seasonally accessible passes. Pir Panjal, which may be taken as a great cultural divide between the regions to its north and south is more so here. To its north are the valleys of Pangi and Lahul, where the social structure, religion and customs are markedly different from those prevalent in the south. The average level of these valleys is between 3000 and 4000 metres. Cultivation is sparse. Barley is the only grain grown. Wheat and maize can grow in lower valley bottoms only. "Kuth" a kind of root crop is extensively grown as a cash crop. The root has medicinal values, and is exported to the Far East. Its cultivation is extending in the region. High pastures are suited to sheep rearing. Summer pastures are located on huge fluvioglacial fans over which some grass grows. They are called "Thaches." The majority of the inhabitants are Budhists and follow "Lamaism". Lahulis are polyandrous. Budhist monastries are a feature of the landscape. Only a few trees grow in sheltered valleys. The weather is usually dry, cold and windy.

Perhaps the drought is gradually increasing. A shrinkage of glaciers is very much evident. This was observed in the Gangstang glacier[9] north of Keylang. Life of people in this region is very hard. A jeep road has been built up to Keylang from Manali in Kulu.

Along the crest of Pir Panjal in this portion, rounded landforms are absent. The divide is sharp and spurs from it are likewise sharp. A close-up of the crest in the bottom left of Plate II reveals these features. The same photograph shows a portion of a small meadow, 3 kilometres below Rohtang pass, in the foreground. The road to Rohtang Pass from Koti rises up in steep zigzags and passes between two conical peaks on the crest. One of them is Beas Rikhi (4631 m), while the other is slightly higher (4652 m.) The Beas river rises here from snow beds and flows below the road to its east (Plate II, top left photograph).

The southern slopes of Pir Panjal in its eastern portion contain a number of closed basins. One of them is the basin of river Siul. In the north and east it is sealed by snowy peaks and the steep rocky crest of Pir Panjal, and in the south and west by two of its spurs. Population and paths follow the stream courses, and the focus is at Tisa, a big village located at the junction of three streams. Above cultivated valleys are dense pine and deodar forests, some of them being very well preserved. Above the tree line are high pastures. Being nearly completely isolated, the valley has developed a distinctive culture. This may be said of the whole of the district of Chamba, which is drained by the Ravi. The people of Chamba are called Chambials.

The town of Chamba is sited on a broad, flat terrace. On the opposite bank also there are extensive terraces on two distinct levels, providing good cultivable rice lands. So the supply of food and water is assured. The motor road to Chamba has been constructed only recently. This explains the uniqueness in the life and habits of Chambials.

The upper reaches of the Ravi consist of a high snow covered area, called Bara Bangahal. A number of medium sized glaciers feed the headwaters of Ravi. Some of them are more than 10 kilometres long, such as the Shah glacier. Gaddi nomads, roam the high pastures below the snow line. The only village in this snowy waste is Bara Bangahal at the exit of this cul-de-sac, where Kalihen stream pierces the ring of snowy peaks and proceeds down towards Chamba.

In Kulu, the upper Beas valley comes down below 1500 metres below Manali, below which flat terraces have developed extensively, providing space for horticulture (specially apples) and rice fields. Higher up are maize fields,[7] followed by dense deodar forests. Potatos are being produced increasingly and are exported. Inaccessibility has again put its stamp on the cultural traits of the people of Kulu. On the higher slopes above the forests are pastures where Gaddis roam with their sheep and goats during summer.

Morpho-ecology of Pir Panjal and its flanks is of absorbing interest, and the above discussion illustrates how strongly the physical environment influences man in this region.

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# REGIONAL PLANNING FOR INDIA

K. S. Ramachandran

## I. Introduction :

With the growth of the Public Sector, the Private Sector goes into the background, and with that, private planning-or unplanned planning, loses all its practical utility. In the First Five-Year Plan, the Private and the Public Sectors had 50% each of the finance set apart for plan expenditure. The proportion of funds for the Public Sector has gone up to 61% in the Second Five-Year plan and in the Third plan, it is proposed to make it 65%. It is expected that this trend will continue and more and more of our economic activities will be brought under the Public Sector. The results of the two five year plans are proof of the efficiency of the Public Sector and one does not need to make experiments, as Dr. Pigou had suggested, to find out whether the Private or the Public Sector is more efficient. Pigou's experiment,[1] as it is, is a costly one and impracticable. It is not possible to ask both the Public Sector and the Private Sector to build steel projects of their own and also produce steel under similar conditions, and then compare their respective outputs and see which is best. The Public Sector has functioned well for these last ten years and it is only to be expected that it takes over, in the coming years, the entire economic activity, now controlled by the Private Sector. When the expected changeover is completed, public planning or planned planning becomes a practical necessity.

Will the Planning Commission at the Centre be in a position to shoulder the responsibility and burden of making plans for every economic activity throughout the country and implement them in the most efficient way ? One cannot be very sure of that. Formerly the Private Sector made its own arrangements for carrying on its activities and now the Planning Commission is expected to make plans for the activities of the Private Sector also. This means increase in responsibility for the Planning Commission and more work too When more work has to be done the Adam Smithian principle of Division of Labour[2] has to be adopted. Herein lies the utility of "Regional Planning" or planning for regions.

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1. A.C. Pigou, "Economics of Welfare".
2. Adam Smith's "Wealth of Nations".

Further, when the technique of planning is unfolded in its geographical setting, which is the only way to make planning decentralised and effective, it gives rise to the concept of regionalism. In a country of continental dimensions such as India and characterised by unevenness in the distribution of occupational opportunities, the regional concept of planning becomes an economic and a social necessity.

## II. The Planning Commission Of To-Day.

(a) *Present constitutional set up of the Planning Administration of the country.*

At the top there is the Planning Commission comprising mostly prefessional politicians. The Chairman of the Commission is also the country's Prime Minister. The Commission is predominantly a political body though it is assisted by a Panel of Economists. The Commission allocates its work among its various members on the basis of their aptitudes and experience. The member who has some knowledge of agriculture is left in charge of planning for agricultural development and the member who has for long been an administrator is left to look after the administrative side.

As regards the constitution of the Planning Commission there are two opposing view points. The administrator's point of view is brought out in Mr. Appleby's masterly report[1] wherein he has made a critical analysis of our system of public administration. He feels that the Planning Commission must be more or less a political body in order to inspire people into activity and induce them to play their part in self development. Without people's cooperation, plans, however well made, cannot be fruitfully implemented. Their imagination could be roused and their cooperation secured only by the politician. The politician may be an amateur, but it is necessary, says Ramsay Muir[2], that he takes on the garb of an executive and inspires his men into action. Maurice Zinkin writes[3] in one of his recently published books on economic development of underdeveloped countries, that it is only a U. Nu or a Nehru who can make people act and even the best of administrators cannot do that effectively.

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1. Mr. Appleby's "Public Administration in India"—Report of a Survey.
2. Ramsay Muir's famous book on the constitution of Great Britain.
3. His recent publication, "Development of Free Asia".

The economist's view is different and the most representative criticism comes from Prof. D. R. Gadgil The economist's suggestion is that the Planning Commission should be a non-political body and be manned by economists and men of administrative experience and ability.

(b) *The Work of the Central Planning Commission.*

(i) **Planning for progress :** The Planning Commission, has, first of all, to draw the general outline of a plan for the progress of the country, keeping in mind the conditions prevailing in the country and the basic objectives of planning laid down by the National Development Council. From the data available regarding national income and the various sources from which it is derived, and bearing in mind the demands made by the various State Govts., the Planning Commission formulates plans for progress keeping in view the fact that all plans made are for the maximum good of the people ; this human approach is the politician's valuable contribution.

Generally, private bodies such as business firms, corporations etc. when drawing an outline of their programmes for business, adjust the ends to means at their disposal and keep an eye on monetary profits. This is not entirely the case with the Planning Commission. Even though a thorough study of the existing financial and real, material and immaterial resources is always made, the decision regarding the targets to be achieved is taken earlier and attempts are made later to find the necessary means.

**ii. Allocation of Resources :** Our Planning Commission plans expenditure for progress on the basis of the country's potential resources, which is different from the actual monetary resources and allocates these resources among the various sectors on the basis of priorities .... so much for agriculture, so such for industry, etc ...

On the basis of the country's needs as formulated by the various State Govts. and on the basis of the capacity of the various sectors to devlop, the Commission distributes funds among the various developmental programmes. The Commission has to use its discretion in the matter of distribution of funds. There is also the question of division of the resources between the public sector and the private sector, demanding the Planning Commission's particular attention.

**iii. Plan Implementation :** After the plans have been drafted and the financial resources allocated as between the various sectors and divisions on careful consideration of the requests from various State Govts. and detailed discussion with the States Ministers, comes the implementation part of planning. That is the most difficult phase of planned development and in this task the cooperation of the Centre and the various States is essential.

In unplanned free economy, things ought to move in perfect rythm, *Ceteris Paribus*. Free economy is "free" in the sense, that the economy moves along without any exogenous control.[1] If the economy is really "free", there is no problem at all. In actual practice there is no absolute "free economy". Even the most perfect example of a free enterprise economy viz. the U.S.A. is not truly a free system as there are monopoly elements in it. But the really "free" economy ought to be a stable one with the various factors being self-adjusting. In such a system, when there is a rise in the price of a particular commodity, the demand automatically falls or rises depending on the elasticity of demand and the nature of the commodity. The rise in price, would also have induced the producer to produce more, or less. depending on the elasticity of supply.

Assuming that the demand falls, there would be a fall in price. This fall in price discourages production, but encourages a rise in demand. Things move on, this way and that way, for a while and at a certain price level, both the supply and the demand would be equal and stability achieved. This is in accordance with Kalecki's exposition of the "Cobweb Theorem". Thus the free economy is self adjusting if it is really "free" and the main factor which gives the system this peculiar characteristic is the free price mechanism.

In planned economy this free price mechanism does not exist. It is the planner's responsibility to replace this mechanism with price controls. In a developing economy, prices very often fluctuate and the planner has to exercise control on the movement of prices and keep them stable. Generally in such an economy, prices tend to move in an upward trend and this upward movement of price levels in the country creates an inflationary spiral, and if not controlled at the proper moment, will

1. See Abba Lerner's "Economics of Control" for discussions on the need for a controlled economy in order to make free competition really free".

raise the general cost of development. Thus price controls and the achievement of progress with stability, are vital functions of the Planning Commission.

**iv. Balanced development of the economy :** Fluctuations in price are mainly due to imbalance in the growth of the economy. Only balanced development of the different sectors in the various regions will ensure stability of the general price level. The development of regions should be entrusted to the regional planners, when "regional planning" becomes the order of the day. The development of the various sectors should be coordinated. When, say, a capital goods industry is started in a region, more employment is created and more money income too, implying more purchasing power. This means that more consumers come to the market in search of consumer goods. If a certain correlation is maintained between developments in both the industries, production of consumer goods would be adequate to demand.

Vice versa, if a large quantity of capital goods is produced in a region for which there is no demand from the consumer goods industries in that region or elsewhere, the capital goods industry will be adversely affected. As a result, there will be widespread unemployment in the capital goods industry which implies fall in demand for consumer goods. Such a thing does not ensure development of the economy with quickness and ease.

Speedy development of the industrial sector without the necessary emphasis on development of the agricultural sector will also create conditions of instability. Rise in demand for raw materials and food grains for use in the industrial sector necessitated by the growing needs of industry, will be followed by rise in prices, if no attempts are made in advance to develop the agricultural sector and increase its productive capacity.

It is the planner's responsibility to plan in such a way that progress is not retarded by imbalance in the development of the various sectors of the economy, viz. industrial, agricultural and commercial sectors.

(v) **Distribution of the fruits of planning :** Though this comes last, it is the most important factor in planning.

Plans are made for the good of the people and it should be seen that the maximum benefit accrues to the people at large. It should also be seen that the undeveloped and underdeveloped

areas are developed to such an extent that they do not need any special attention in plans for the coming years.

It is the duty of the planner to see that the benefits of planned development are distributed on an equitable basis to all people and that the plans do not result in lopsided development.

To sum up, the Commission should see that the aim of planning, viz. the creation of maximum social welfare, is achieved at minimum cost.

### III. Significance of Regional Planning :

Planning according to Whittle and Hirsh[1], is "inevitably a compromise between the socially desirable and economically possible". It ought to proceed on the basis of the existing distribution of resources and the feasibility of developing them. As Hilber Seimer says[2] "Regional planning is an all comprehensive task. It deals with life itself, with the present and the future. It involves science as well as art. Science could help to determine the region adequate to our intentions, achievements and possibilities for the benefit of the people". The importance of regional planning is again emphasised by W. G. Halford in his introduction to Town and Country planning Text Book edited by APPR. It is meant "to create a pattern or design which is pleasing and effective and which corresponds to that inner sense of fitness and wholeness which has always been part of the spirit of progressive man."

### IV. What is a Region ?

L Hilber Seimer defines a region as "an organic entity, an organism, in which the whole is related to the parts, as the parts are related to the whole. A region is one which can live and support life. It is an interrelated part of a country, a natural unit, self-containing by reasons of geographical advantages, natural resources, and soil conditions, natural and man-made, transportation routes developed and used by its population".[3] The important features of a region according to Arthur E. Smailes are :[4].

(1) Geographical Unity and natural cohesion.

(2) Economic unity

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1. Jack. Whittle and J. M. Hirsh, "Realisation of a Development Plan".
2. L. Hilber Seimer, "The New Regional Pattern".
3. L. Hilber Seimer "The New Regional Pattern".
4. Arthur. E. Smailes "Planning Regions and Geographical Associations".

(3) Social unity
(4) Administrative convenience.

E.G.R. Taylor defines a region as "a unit area of the earth's surface distinguishable from a mere area by the exhibition of some unifying characteristic or property. The unifying factor may be a natural one or it may have been imposed on the area by some form of human use."[1]

In this context, Jacqueline Tyrwhitt, says "Planning ..... relates to the development of the entire region, regardless of administrative boundaries. Only through planning for the total community can the organic structure of its economy, its social needs and its physical development be understood. Only in this way will it be possible to take into account the interdependence of the parts of the area."[2]

Generally speaking, regions are entities, characterised by uniform standards of economic, social and political progress and potentialities for further development.

Within the region thus defined, there could be balanced production, based on diversified agriculture, and on industries making use of the native raw materials. Each community and each individual would have an equitable share in the prosperity of the region and everything would be planned for the benefit of the individual as well as for society as a whole. Thus an organic regional life could be created which would be an economic, social and cultural entity.

## V Delimitation of Regions in India :

E.G.R. Taylor suggests[3] five methods of delimitation of regions :

(1) The grouping of administrative areas.
(2) Separation of areas according to metropolitan influence.
(3) Use of single function areas.
(4) Use of areas possessing administrative convenience.
(5) Use of geographical regions.

India can be divided into many regions on the Geographical, Physiographical, Geological, Political, Sociological and on Economic bases.

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1. E G. R. Taylor "Regions of Britain".
2. Jacqueline Tyrwhitt "Surveys for Planning".
3. E.G.R. Taylor, "Delimitation of Regions for Planning purposes".

**(a) Political and Sociological :** The country can be regionalised on a political basis. The present day states are regions demarcated on a political basis, taking into consideration, the languages spoken by the people. The division of the country which, in 1947, had the best chance of becoming more a unitary state than federal, into various states could be regarded as having been necessitated by political considerations. Taken in this context, regional planning on the basis of States, has to be regarded as matter of political necessity.

While political division of a country is, generally speaking, necessitated by occurrences of a political nature and is therefore of a revolutionary type, sociological division is of an evolutionary nature and takes place gradually with the passage of time. A region inhabited by people with a single common code of behaviour and customs and speaking the same language can be called a sociological region. The tendency to become parochial is inherent in the people. In the modern set up in India, political division of the country is almost the same as sociological division.

**(b) Economic regions :** For economic regionalisation of a country economic activity is the criterion. The three spheres of economic activity in India or in any country, are Agriculture, Industry and Commerce and on the basis of these, the economy could be divided into three sectors, the agricultural sector, the industrial sector and the commercial sector. India, a few years ago, was a large agricultural sector, but today the position has changed significantly under the impact of planning.

*(i) Features of the agricultural sector.*[1]

The agricultural sector in India depends for its prosperity on the monsoon and man-made irrigation projects. It is the largest sector, employing about 70% of the population, for whom, it is the main source of livelihood, People employed in this sector are fully employed only upto the harvest time, after which they are practically without occupation. This sector is the backbone of our economic system, as all other economic activities depend for their successful completion, on the fruits of agriculture. The consumer goods industries get their raw materials from agriculture. The people of the country are fed by crops produced on land. The entire economic activity hinges on agricultural produc-

1. Vera Anstey—"Economic Development of India".

tion, and agricultural prices determine the general price levels In effect, agriculture influences the overall economic prosperity of the country.

The dependence of agriculture on the monsoon and vagaries of nature makes the development of this sector somewhat uncertain, though with the advance of science, we are now in a position to counteract some of the evils brought about by uncertainties of nature. Dams and other flood control measures and irrigation projects provide, in some measure, water required for agriculture in controlled quantities. But even these fail during times of nature's cataclysms and production is affected.

Agriculture is different from industry in that the ordinary laws of economics are inapplicable to the former. The economic laws of supply and demand are not true of agriculture. When demand for say, wheat, rises, production does not go up automatically to meet the rise in demand. In the long run, attempts could be made to produce according to demand. But unseasonal rains might actually lower production, even assuming that the area under wheat cultivation had been increased ; vice versa, when demand falls, production cannot be expected to decrease automatically.

As already stated. this vital sector provides employment for nearly 70% of our population, though only for a few months in a year, and for the rest of the year the agriculturists are under-employed, if not totally unemployed. This feature of agriculture is a disconcerting factor in our economic development. More so, because of the fact that even those employed for a few months in agriculture do not have a full day's work to do. It is estimated that half of this number will be sufficient to do the work now done, meaning thereby that more than half of those employed in agriculture are just wasting their time and energy and they could be fruitfully employed in the industrial sector. This under-employment in the agricultural sector necessitates speedy industrialisation of our country which alone can provide ample sources of employment for the surplus hands depending on agriculture.

This sector is mostly static and its problems are peculiar to itself. Even so, the fact remains that it is a vital link in economic development and it is an important determinant of economic progress. This significant facts makes it necessary that plans made for the other sectors should only be in coordination with the plan made for this sector.

(ii) **Features of the industrial sector :** The general laws of economics are true of the industrial sector. The economic theories that we know, have been formulated on the assumption that the economy is industrial. The economic problems mentioned in text books on economics, are in reality problems of the industrial sector.

The industrial sector is dynamic. As a matter of fact, the economic organism of a country moves in cycles because of the dynamic character of its industrial sector. The size of this sector is one of the yardsticks to measure the extent of development of the country, though there are significant exceptions. Holland, Denmark, and New Zealand have largely agricultural economies and their wealth is derived mostly from the earnings of the agricultural and allied sectors such as dairy farming, but even so, the countries are more well developed than some industrial nations. These are exceptions, but generally economic development goes with industrialisation. The industrial sector is "fertile[1] according to the nomenclature of the Physiocrats[2]-It gives value to the raw materials from land. Raw materials by themselves have no value and only when they are manufactured into finished goods, they are given shape and value. It is the industrial sector, which creates the demand for products of agriculture. It provides the transport system which makes easier the transport of agricultural products from the field, to the market. It is only this sector which can absorb the excess population dependent on land. But being a dynamic sector, it creates economic instability. Trade cycles[3] or cyclical fluctuations are features of an industrial economy and as such, unemployment is a rampant malady of this type of economy, whereas in agriculture not many are really unemployed and every one works on land, though only for short periods.

The growth of the industrial sector implies increase in the bargaining power of labour. Labour exercises a great influence on the working of this sector. When the prices of consumable agricultural goods go up, labour demands wage rises and when wages rise, the cost of production goes up. As a result, industrial prices rise, and we have the phenomenan of wages and prices

1. The reader should not be misled to think that the physiocrats really believed that the industrial sector was "fertile". Actually they did not.
2. Eric Roll 'History of Economic thought". Quesday's "Tables"
3. Prof. Haberler, "Prosperity and Depression"

chasing each other[1]. The economic strength of labour, as directly contributing to production, and at the same time as consumer of what it produces, is a powerful force in an industrial economy.

(iii) **Commercial Sector :** The commercial sector is the link between the other two economic sectors and grows with the development of these two. The persons employed in this sector are mostly middle men and their prosperity depends on the prosperity of the agricultural and industrial sectors and on healthy conditions of trade. This sector does not therefore require any special planning for itself.

## VI. Regions on the basis of Economic development and Criteria for Their classification:

Regions can also be constituted on the basis of economic development, for planning purposes. Plans need to be different for areas according to their stages of development. Fundamentally, we can classify the whole country into five regions on the basis of development, viz. (1) Undeveloped-but development of which is not economically possible in the short run (2) Undeveloped but which can be developed in the short run (3) Underdeveloped (4) Moderately developed (5) Well developed.

When classifying a region, the social and economic conditions prevailing should be taken into consideration. The actual and potential wealth and income of the area, the nature of the soil, the existing population, and the rate of its growth, the number of people fruitfully employed and those underemployed and unemployed, the standard of output, its existing natural recources and potential resources, its agricultural and industrial growth-all these constitute the economic criteria. The standard of literacy, and health of the people, the food available for their consumption, their purchasing power, their productivity or capacity for work, their temperament etc., constitute the social criteria. A preliminary survey of all the areas and a thorough study of the prevailing conditions in these areas will help easy classification.

## VII. Classification of Regions on The Basis of Economic Development :

As stated in the foregoing paragraph, regions con be formed on the basis of their economic development as follows :

1. Prof. Taylor, "Economics of Public Finance", Prof. A. C. Pigou "Economics of Welfare".

(a) *Undeveloped region-but where development is economically impossible in the short run.*

The features of this region are, the barrenness of the soil-impossible of cultivation for many years to come, and absence of resources for fruitful exploitation. Take for example, the Rajasthan desert. This is an undeveloped region, the development of which is an economic impossibility in the short run. Dealing with the possibilities of developing this barren land, an eminent economist and demographer remarked in the course of a lecture, "Supposing that this desert is made fit for cultivation and bread is made out of the wheat produced on it, the cost of one loaf will be more than what it would be if one loaf is imported from abroad, toasted and buttered and is served to you by a pretty waitress, also imported from abroad."

It is quite possible, theoretically, to feed the desert by canals linked with the Bakra-Nangal dam and attempts could also be made to make the desert fit for cultivation by complete replacement of soil as has been done in the desert regions of Israel. But will that be economically feasible in the foreseeable future ?

Does the desert have any other utilities ? Can anything be made of the sands which fill the desert ? Can any salts be found or any minerals be dug out of it ? Is there any possibility of finding oil there ? Can anybody from the densely populated areas be attracted to colonise this region ? All these questions come up when we think about the uses to which the vast desert land could be put. The economist can only come to the rational conclusion-uninfluenced by the politician's dogmatism or his saintly optimism-that the desert belongs to the first category, viz., the land is undeveloped and can be developed only with great difficulty, meaning threby that development of the region is an economic impossibility.

(b) *Undeveloped region-but which can be developed in the short run.*

This region is one, which is presently undeveloped but which can be developed without much difficulty and without much wastage of real and financial resources and also within a short period. Development of such a region is economically feasible.

In this region no attempts have been made as yet to develop it. It has potential resources which can be exploited and fruitfully made use of. Most parts of India, which are now rich agri-

cultural areas or partly industrial regions, were, till a few years ago, undeveloped. The Digboi of today was when geological surveys of the area were made, an undeveloped area but with potential resources for development The vast areas, which have newly been brought under the plough as a result of the new irrigation projects were, a few years ago, undeveloped. Large tracts of lands which were fallow on account of salinity of soil or waterlogging, have, by the application of science, been turned into fertile fields. Soil surveys will show which land can be developed and which cannot be. Geological surveys will show which of the areas contain coal and mineral deposits or in which oil can be found. Industrial surveys will also show whether any industries can be located in the area under survey, depending on the availability of labour, raw materials and capital.

(c) *Underdeveloped region :* The underdeveloped region, when developed, soon reaches the stage of under-development. At this stage, some parts of the region have been brought under cultivation, but these can be enlarged and cultivation of the existing areas intensified by the adoption of more scientific methods. The earnings of this region are not what they can and should be. Its potential earnings are still more than its actual earnings. There is a surplus of labour in agriculture and there are not enough industries to absorb the surplus. Economic cultivation of land does not exist and acutal production is much below its potential capacity to produce.

Industries are also insufficiently developed. They are not in a position to develop any further because of inadequacy of capital. The savings of the people of the area are not much and even these are not fruitfully invested. Industrial development is lopsided, a few industries being overemphasised and the others ignored. Demand for industrial goods is not much and there is no encouragement for further production. The standard of living of the people is still low and incomes are low. Unemployment exists in the industrial sector and underemployment is a prominent feature of the agricultural sector.

Generally, these regions have potentialities for further development, but remain underdeveloped due to the absence of economic aids for productive utilisation of its potential resources. In this sense, many parts of India before independence could be regarded to have been underdeveloped regions.

(d) *Moderately developed region :* A moderately developed region is one which has left the shores of underdevelopment and is fast developing. At this stage, the region is a moderately developed one and acquires new characteristics.

All the available lands for cultivation have been brought under the plough, while a few tracts treated as waste remain uncultivatated. Irrigation facilities have been made available for lands, credit facilities have been extended increasingly, due to the fact that more lands have become fertile and less lie fallow, and also more scientific methods have been applied. Agricultural output and incomes have risen.

Along with these developments in the field of agriculture, the industrial sector has grown in size and strength. The majority of the surplus population in the agricultural sector has been absorbed by the industries. The standard of living of the people has gone up. Inequalities in the distribution of incomes have decreased.

Even so, there is scope for further improvements. Under-employment still exists in the rural areas and unemployment in the urban areas. This region is still not in a position to utilise all its resources. The region has not achieved self-generating capacity-meaning thereby that the surplus above subsistence is too small for development in the future. The region has scope for further development.

There are some areas in present-day planned India, which having been developed under the two plans, correspond to this type.

(e) *Well-developed regions* : These areas are in an advanced stage of development, the final stage any economy can reach after passing through the various earlier stages. A region of this type will be in Hansen's words, a "mature economy", facing the possibility of "secular stagnation". In this region, the factors of production are fully productively employed, output is the maximum and incomes are the highest. The standard of living of the people is at the optimum level. Savings are high and there is a surplus of it for carry-over to the next few years.

In India, a few areas can be said to have achieved this final stage in respect of agriculture. But, in industry, possibly none Such well developed areas cannot be developed any further

quantitatively ; yet they require constant attention to consolidate the progress achieved and improve output qualitatively.

## VIII. Regional Planning on the Basis of Economic Development-A Practical necessity for India.

As mentioned earlier, planning for regions has acquired new value and more importance, since the field of public planning has been enlarged. Planning has to be comprehensive, taking into account the needs of the various areas and their potentialities for development. The Central Planning Commission is not fully aware of the peculiar characteristics of the different areas, and cannot therefore make adequte plans for them. They have to look up to the State Governments for suggestions, and State Governments in their anxiety to develop their own States to the maximum extent possible, tend to lose sight of the needs of the other States, and to insist on full development of their own areas at the cost of others. The Central Planners have to consider the exaggerated and conflicting claims made by States and to trim the plan according to the resources available. In practice, the most vociferous States get a better deal than the more silent ones and the result is lopsided development. To a certain extent, it is true that the State authorities have accurate knowledge of the needs and potentialities of their respective areas and are the best judges of what is good for their own people ; but they are apt to ignore the technical aspects, involving availability of raw materials, adequate supply of manpower-technical and otherwise, transport facilities, water supply, power, etc., in their anxiety to develop their areas. With the best intentions in the world, the State planning bodies cannot avoid being parochial, and are apt to attach more importance to their own needs.

It is therefore necessary that new Regions are formed for planning purposes, to make the task of the Planning Commission easier, which should not be on the basis of linguistic or political units, but should out across the barriers of linguism, statism and parochialism. As mentioned already, planning should be for the maximum welfare of the largest number of people and must therefore be evolved and implemented on national lines, and not at the dictation of narrow provincialism. Emotional integration of this country is what is urgently needed, and this can be achieved only by thinking and acting on broad national lines and not on narrow sectarian or sectional considerations.

## IX. Formation of Regions for Planning Purposes.

Having established the necessity for planning for regions on the basis of economic development, and the need for planning on a national basis untrammelled by parochial considerations, it now remains for us to suggest the formation of Regions solely for the purposes of planning and implementation of the plans made. While doing so, care should be taken to group the undeveloped areas which could be developed in the short run, with the well-developed areas, and the under-developed areas, so that the weaker areas can draw upon the resources of the stronger areas. It should also be ensured that industrial and agricultural areas are grouped together as far as possible, so that balanced development of industry and agriculture can be achieved. The undeveloped areas, the development of which is an economic impossiblity in the short run, should be excluded from the scope of planning until such time as the resources of the other and more productive areas have been exploited to the fullest extent.

On the basis of the foregoing, we may divide the whole of India into five broad regions solely for the purpose of planning :

(1) **Eastern Region :**
(a) West Bengal (b) Bihar (c) Assam (d) Tripura (e) Manipur (f) Orissa, and (g) Andaman and Nicobar Islands.

(2) **Southern Region :**
(a) Andhra Pradesh (b) Madras (c) Kerala (d) Mysore (e) Laccadive, Minicoy and Amindivi Islands.

(3) **Western Region :**
(a) Maharashtra (b) Gujarat (c) Rajasthan.

(4) **Northern Region :**
(a) Punjab (b) Jammu and Kashmir (c) Himachal Pradesh (d) Delhi.

(5) **Central Region :**
(a) Uttar Pradesh and (b) Madhya Pradesh.

Each region should have a Planning council comprising,

1) a Minister from each of the States
2) a representative of the Central Water and Power Commission
3) an economist who has a thorough knowledge of the region
4) a representative of the Geological Survey of India

5) a Geographer-cum-Pedologist, and presided over by a member of the Planning Commission. The Regional Planning Councils should draw plans for the development of their respective regions and submit them to the Central Planning Commission for approval. They should also specify the physical targets to be achieved and also the financial resources available. The Central Planning Commission will make an objective study of the recommendations of the Planning Councils and in consultation with the National Development Council, fix the targets for each region and allocate funds. They should, in the words of Ragnar Frisch[1], follow three logical steps in the finalisation of plans, viz :— "(1) statement of desired ends (2) specifying the list of activities—possibilities too, (3) determining the optimum combination of targets." The States will continue to implement the plans finally approved, but the Regional Planning Councils will have the responsibility of evaluating the progress made in the implementation of the plans from time to time. Plans made and implemented with prudence and forethought will bring all-round prosperity to our country and in course of time, we can take our place of pride among the advanced nations of the world.

1. Ragnar Frisch, "Planning for India".

# FERTILITY CLASSIFICATION OF THE SOILS OF THE VILLAGE ARAMBAGH AND ITS ADJOINING AREAS

( DISTRICT HOOGHLY, WEST BENGAL. )

**S. P. Chatterjee, R. Lahiri, and R. N. Choudhury.**

Soil fertility and productivity do not mean the same thing. A soil may be fertile without being productive or *vice versa*. Whereas the fertility of the soil indicates the capacity of the soil to produce crops, productivity signifies the net result of that inherent capacity brought to an optimum condition by the proper management of the soil. The factors which interplay in the schematic soil fertility classification are soil texture, pH, and the contents of organic carbon, calcium, nitrogen, phosphorous and potassium in the soil. Of these, again, nitrogen, phosphorous and potassium are very important for healthy and vigorous growth of plants. In order to maintain a balance between soil fertility and productivity, the N. P. K. levels in the soils should always be kept high.

For the best use of the land, the most urgent need is to have such a classification of soils which could be of practical use to the farmers. In parts of Europe, systems of soil classification for agricultural use were, at one time, based simply on the fertility status of the soils which, in each individual case, was assessed on the results of physical and chemical examination of the soil. In Russia, it was done by some iso-humus and iso-carbonate lines whereas, in Germany, such classification was done on the basis of summation of points. The soils of the region were examined from various aspects and points were awarded to each ; the total of the points thus obtained indicated the fertility status of the soil. The U. S. A., on the other hand, has adopted a system of soil classification on the basis of productivity ratings which are estimated from the crop yields obtained under good, average or bad management.

The village of Arambagh (Lat. 22° 45′ to 23° 0′ N and 87° 45′ to 88° 0′ E Long.) is situated between the two main rivers of Hooghly District viz. the Mundeswari and the Dwarkeswar. The area is an alluvial plain and nowhere any break of surface relief is noticed. Although there are a few high and low lands growing rice, the maximum height nowhere exceeds 50 feet. The area is under the ravages of flood which occur almost every

alternate year. The effect of these floods is not always harmful because the fields are sufficiently enriched by the deposition of fresh silt. The average annual rainfall in the area ranges between 1397—1651 mm and the temperature is hot and moist in summer and moderately cool and dry in winter.

This is an area of alluvial soil. The soil reaction is acidic to neutral. The pH values range from 4.0 to 7.5. But the majority of the soil samples show pH value of 5.5. The following table shows the pH values of the different soils examined.

TABLE 1

| Sample No. | pH value. | Sample No. | pH value | Sample No | pH value. |
|---|---|---|---|---|---|
| 1 | 7.5 | 4 | 4.0 | 7 | 6.0 |
| 2 | 5.0 | 5 | 5.5 | 8 | 5.5 |
| 3 | 5.5 | 6 | 5.5 | 9 | 5.0 |

Texturally the individual soil samples do not show wide variation. Most of these are loamy soils, ideal for any type of cultivation. The following table shows the mechanical composition of these soils.

TABLE 2

(Values on %-air-dry basis)

| Sample No. | Coarse sand | Fine sand | Silt | Clay | Loss on sol. | Total | Texture* |
|---|---|---|---|---|---|---|---|
| 1. | 6.90 | 43.23 | 13.00 | 34.50 | 1.40 | 99.03 | Sandy-clay |
| 2. | 12.80 | 60.92 | 5.00 | 20.00 | 0.70 | 99.42 | Sandy-clay loam |
| 3. | 8.00 | 46.28 | 8.50 | 34.50 | 1.30 | 98.58 | Sandy clay |
| 4. | 56.30 | 10.00 | 5.00 | 27.00 | 1.60 | 99.90 | Sandy clay loam |
| 5. | 11.60 | 59.75 | 7.75 | 19.75 | 0.70 | 99.55 | Sandy clay loam |
| 6. | 6.90 | 30.00 | 29.50 | 30,50 | 1.30 | 98.20 | Clay loam |
| 7. | 4.20 | 40.60 | 29.50 | 20.00 | 0.70 | 98.00 | Loam |
| 8. | 2,50 | 48.50 | 19.25 | 27.75 | 1.30 | 99.35 | Sandy clay loam |
| 9. | 34.08 | 1.80 | 22.50 | 40.25 | 1.30 | 99.93 | Clay |

Excepting the samples 6, 7 and 9, all are sandy clay loam. The percentage of sand ranges from 50 to 70. Such a high percentage of sand in the textural complex indicates free drainage and the least chance of water logging. Sample 7 is the best in comparison to others, but it is rather deplorable that in this

*As per U.S.D.A. manual of Soil Survey.

particular field neither farmyard-manure (F. Y. M.) nor inorganic fertilisers are applied. The yield is very low.

Next to the textural analysis comes the productive capacity of the lands. As regards productive capacity the village Arambagh and its adjoining areas are favourably situated as compared to the other parts of Hooghly district. The following table is given to show the productive potential of the village Arambagh.

TABLE 3

| Sample No. | Village | P.S. | Crops grown | With fertilisers Application per acre/yield per acre (A) | Without fertilisers, F.Y.M. Application per acre/yield per acre (B) |
|---|---|---|---|---|---|
| 1. | Hat Bas-antapur | Aram-bagh | Potatoes | No fertiliser | No F. Y. M. 60 mds per acre |
| 2. | Aram-bagh | do | Rice (medium) | Ammonium Sul-phate, 36-60. mds. per acre/39-42.mds per acre | F.Y.M. 1-2 cart loads per acre/30-36 mds per acre. |
| 3. | do | do | Rice (Lowest) | No. fertiliser. | No F.Y.M. 30. mds per acre |
| 4. | do | do | Upland Jute | No fertiliser | No F.Y.M. |
| 5. | do | do | Rice (highest) | Same as 2A | No F.Y.M. |
| 6. | do | do | Rice medium) | Same as 2A | No F.Y.M. |
| 7. | do | do | Rice (Lowest) | No fertiliser | F.Y.M. 1-2 cart loads per acre/30 mds per acre. |
| 8. | do | do | Rice (Lowest) | No fertiliser | F.Y.M. 1-2 cart loads per acre/30mds per acre. |
| 9. | Balibela | Go-ghat | Rice (Lowest) | No fertiliser | No F.Y.M. 27 mds per acre |

From the above table it may be concluded, that most of the farmers of the village use $(NH_4)_2 SO_4$ as inorganic fertiliser and with the addition of this fertiliser, production potential of the rice fields have gone high (rice is the main crop of the area). Next to rice comes jute and potatoes. Although jute has an overall monopoly in other parts of Arambagh subdivision, it is cultivated

on a small scale in the village Arambagh. Potatoes are also significant crop and is mainly cultivated in the winter months, just after rice is harvested. The soil samples were collected from a potato field lying in an experimental plot in which potatoes were experimentally tried just by the side of the Mundeswari Khal in the village Hat Basantapur. The land was reclaimed a few years back and potatoes were introduced. Though yield per acre is very low (60 Mds./acre) even now, it can be raised to an appreciably high level (100-120 Mds/acre) by addition of organic fertilisers.

Next to productive potential, comes the fertility status of the soils of the village, indicated by the percentages of the different plant nutrients and organic matter present in the soil.

TABLE 4

(All values are in%)

| Sample No | Nitrogen | $P_2O_5$ | $K_2O$ | CaO | Organic matter |
|---|---|---|---|---|---|
| 1. | 0.74 | 0.0016 | 0.06 | 0.12 | 1.65 |
| 2. | 0.42 | 0.0017 | 0.09 | 0.16 | 0.40 |
| 3. | 0.10 | 0.0016 | 0.06 | 0.80 | 1.28 |
| 4. | 0.08 | 0.0037 | 0.09 | 0.06 | 1.25 |
| 5. | 0.07 | 0.0020 | 0.09 | 0.10 | 1.27 |
| 6. | 0.28 | 0.0020 | 0.06 | 0.06 | 1.35 |
| 7. | 0.08 | 0.0010 | 0.09 | 0.08 | 1.41 |
| 8. | 0.01 | 0.0016 | 0.06 | 0.14 | 1.21 |
| 9. | 0.01 | 0.0013 | 0.06 | 0.44 | 0.79 |

From the above table, it may be said that the soils of the village Arambagh are potentially rich in plant neutrients that is, N. P. K. and Ca. Both the organic matter and nitrogen level, in the soils of the area are sufficiently high. The reason for such unusually high percentage of nitrogen may be ascribed to the fresh addition of ammonium-sulphate annually.

From the above data, consequently, the fertility indices of various cultivated crops, mainly rice and jute, were prepared. The indices were tabulated on the basis of giving possible marks to each individual plant nutrient. The maximum number given was 100 and keeping in view the 100 as maximum, the rest were calculated proportionately. When all these figures were worked out they were summed up accordingly. Thus an overall picture of fertility index of the village was obtained. The following table shows the fertility indices of the different soils.

TABLE 5 †

| Sample No. | Crops cultivated | Soil texture | Index Number | | | | Fertility Index | Grade |
|---|---|---|---|---|---|---|---|---|
| | | | Organic matter | Nitrogen | Phosphorous | Potash | | |
| 1. | Potatoes | Sandy clay | 100 | 100 | 43 | 66.7 | 310 | 1st. |
| 2. | Rice (medium yield) | Sandy clay loam | 24 | 56 | 44 | 100.0 | 224 | 5th. |
| 3. | Rice (Lowest yield) | Sandy clay | 77 | 13 | 43 | 66.7 | 200 | 7th. |
| 4. | Jute (Upland) | Sandy clay loam | 75 | 10 | 100 | 100.0 | 285 | 2nd. |
| 5. | Rice (Highest yield) | do | 76 | 9 | 54 | 100.0 | 239 | 3rd. |
| 6. | Rice (Medium yield) | Clay loam | 81 | 36 | 54 | 66.7 | 238 | 4th. |
| 7. | Rice (Lowest yield) | Loam | 85 | 10 | 27 | 100.0 | 222 | 6th. |
| 8. | Rice (Lowest yield) | Sandy clay loam | 71 | 13 | 43 | 66.7 | 182 | 8th. |
| 9. | Rice (Lowest yield) | Clay | 47 | 13 | 35 | 66.7 | 150 | 9th. |

The sample No. 1, a virgin soil which is still lying idle records maximum index number. In this particular soil nitrogen, potash and organic matter index numbers are high. If the soil could be managed properly, promising returns of crops like rice, jute and potatoes may be obtained. The sample No. 4, though apparently not having high yields per acre, could be made to produce more if proper management be done. In sample No. 4, high index numbers against phosphorous, potash and organic matter are noticed. The only drawback of this particular soil is that it receives too little water from rivers. It has to depend only upon rain water. The sample No. 9, owing to continuous cropping without any attempt being made to replinish the soil with plant nutrients has deteriorated markedly. As the field is beyond the limits of flood plain, it does not receive fresh silt and moreover it suffers from lack of water and the only means of irrigation is from private tanks. Other soils are moderately fertile, as is evident from fertility indices.

## Reference

1. Report on the Reconnaissance Soil Survey of the District Hooghly.

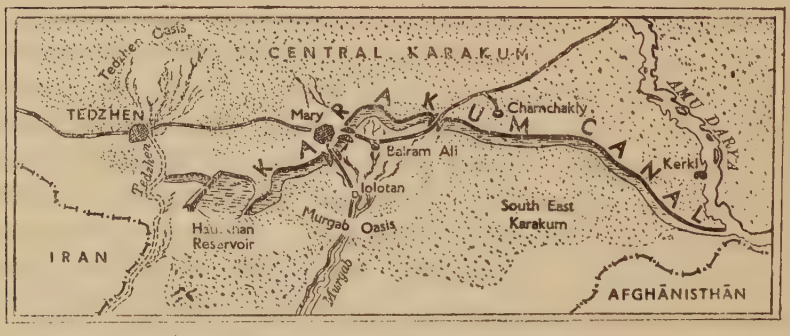
2. Girolamo Azzi (1956): Agricultural Crop Ecology (Constable.)

† In case of Organic matter 1.65% is taken as 100
In case of Nitogen 0.74% is taken as 100
In case of Phosphate 0.0037% is taken as 100
In case of Potash 0.09% is taken as 100

# Geographical Notes

## Karakum Canal

The Karakum navigable canal from the Amu Darya to Tedzhen, having a length of 400km has been constructed. The canal will make it possible to cultivate irrigated farming of 130,000 hectares of fertile land. Beginning with the 50th km from the Amu Darya, the canal follows the ancient riverbed of the Kelifskiy Uzboy, forming a chain of small lakes with a total




length of about 60 km. These lakes are natural reservoirs for the settling of slime. From the 180th to 305th km the canal follows the region of desert sands, where in some places the height of sand hills exceeds 20 m. The summer temperature of the air reaches 46 degrees (C). It took four years and a half to construct the canal.

## SUNDARBANS REVISITED

Two years after the visit of two parties of Fellows of the Geographical Society of India, another party with some previous members and other geographers visited the Sundarbans in March, 1962.

The party landed at Herobhanga Refugee Coloney on the fringe of the forest. The Coloney had produced some rice for the first time. It had further expanded and developed. The number of tigers had decreased and they were no more a menace as they were two years ago.

The party went down the river Matla, Bidya and again by Matla and entered Mayadip creek north of Dalhousie Island. Their motor-launch anchored here for the night, within the forest. A great concentration of luminous organisms (Noctiluca) was observed in the water. Except the occasional whistling of night birds the forest was completely silent at night.

In the morning the party landed on a sandy beach opposite Bangaduni Island. Here a dead forest consisting of stumps of Geon trees was seen. Geon, which grows in mud, was perhaps killed by the deposition of sand. Large spotted deer were seen in the adjoining forest. There was a great concentration of trees with breathing roots (pneumatophores). Muddy flats along the water's edge were full of spikes, which spread in star-shaped pattern from the trunks of trees.

Crabs and small fish slithered along the edge of muddy water as the flow tide came in along a water channel.

The party then went up northwards along Guasaba river. Here Golpata (Nippa fruticans) was seen growing profusely at the water's edge. Large trees such as Gengwa (Excoecaria agallocha), Garjan, Kakra and Garan formed a dense wall of impenetrable forest all along the river front.

The party landed for a third time in an open Geon forest at ebb tide. The ground was covered by breathing roots standing out in hundreds of spikes. Fresh pug marks of a large tiger were seen in soft mud. They were photographed and the party beat a hasty retreat. A group of large monkeys and a pair of deer were also seen further away from here. Except some fishing boats no other human activity was observed at this time. After taking a zig-zag course through the intricate net work of channels, the party came back to Matla river and Canning, after an interesting tour of the Sundarbans.

**S. C. Bose**

# Book Review

MONSOON ASIA by E. H. G. Dobby ( Price : 25 shillings). This detailed work in 311 pages provides a careful and up-to-date geographical analysis of the Monsoon region of Asia. Throughout the five parts of this volume, particular reference has been made to the problems presented by environment, and the re-arrangement of territorial boundaries following the emergence of Asian national movements since the end of the Second World War. Teachers and students of geography will find this book very helpful, much like its predecessor "South-east Asia" by the same author, who has spent many years of his his life in Asian tropics. Detailed topographical maps and sketches and bright photographs are a special feature of the book. India is described in about 40 pages. **S. C. B.**

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The particulars regarding the ownership of "Geographical Review of India", a quarterly journal, are given below as called for by Rule-8 of The Registration of Newspapers (Central) Rules, 1956.

Form VI

| | | |
|---|---|---|
| 1. | Place of Publication : | Calcutta |
| 2. | Periodicity of Publication : | Quarterly |
| 3. | Name of Printer : | D. R. Mitra |
| | Nationality : | Indian |
| | Address : | Calcutta University, Geography Department, College St., Calcutta |
| 4. | Name of Publisher ; | D. R. Mitra |
| | Nationality : | Indian |
| | Address : | Calcutta University, Geography Department, College St., Calcutta |
| 5. | Name of Editor : | S. C. Bose |
| | Nationality : | Indian |
| | Address : | National Atlas Organisation 1, Lower Circular Rd., Calcutta |
| 6. | Name and Address of owner : | The Geographical Society of India, Calcutta University, College St., Calcutta |

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(Sd) D. R. Mitra
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Printed by Sri D. R. Mitra at Usha Printing Works, 209, Cornwallis Street, Calcutta-6 and Published by him from Asutosh Building, Calcutta University, Calcutta.

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